

# Renesas RA Family

## Quick Start Guide: Modbus TCP

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### Introduction

This document is a quick start guide for evaluating Modbus<sup>®</sup> communication with the RA microcomputer evaluation board.

Modbus protocol is a communication protocol developed by Modicon Inc. (Schneider Electric SA.) for programmable logic controllers (PLCs), and its specifications are open to the public.

For details, refer to the protocol specifications (PI-MBUS-300 Rev.J).

### Target Device

RA6M3, RA6M4, RA6M5

RA8D1, RA8M1, RA8T1

RA8T2, RA8D2, RA8P1, RA8M2

### Supported Evaluation Boards

EK-RA6M3, EK-RA6M4, EK-RA6M5

EK-RA8D1, EK-RA8M1, MCK-RA8T1

MCK-RA8T2, EK-RA8D2, EK-RA8P1, EK-RA8M2

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## 1. Overview

This document describes the Modbus protocol stack that operates on the RA evaluation board. It provides an overview of its functions and a Modbus sample application for developing and implementing applications using the protocol stack.

This sample program package supports the Ethernet-based Modbus TCP protocol.

This Quick Start Guide provides:

- Sample program package configuration
- Operating environment requirements
- Evaluation board connection setup
- Procedure for creating, modifying, and building the Modbus sample project using the Flexible Software Package (FSP) and e<sup>2</sup> studio Integrated Development Environment (IDE).
- Instructions for connecting with a client and operating a simple demo.

### 1.1 Abbreviations/Definitions

**Table 1.1 Abbreviations/Definitions**

Index	Abbreviations /Definitions	Description
1	IP	Internet Protocol
2	TCP	Transmission Control Protocol
3	USB	Universal Serial Bus
4	PC	Personal Computer
5	SW	Switch
6	EWARM	Embedded Workbench® for Arm
7	LED	Light Emitting Diode
8	Wireshark	Free packet capture tool to check packets flowing on LAN

## 1.2 Reference

Technical information about Modbus is available through the Modbus organization site, and information about the RA evaluation board is available through Renesas.

**Table 1.2 Technical Inputs**

Index	Technical Inputs
1	Modicon Modbus Protocol Reference Guide Rev.J / <a href="#">PI_MBUS_300.pdf</a>
2	Modbus Application Protocol Specification V1.1b3 / <a href="#">Modbus_Application_Protocol_V1_1b3.pdf</a>
3	Evaluation Kit for RA6M3 Microcontroller Group EK-RA6M3 Quick Start Guide / r20qs0011euxxxx
4	Evaluation Kit for RA6M3 Microcontroller Group EK-RA6M3 v1 User's Manual / r20ut4623euxxxx
5	Evaluation Kit for RA6M4 Microcontroller Group EK-RA6M4 Quick Start Guide / r20qs0016egxxxx
6	Evaluation Kit for RA6M4 Microcontroller Group EK-RA6M4 v1 User's Manual / r20ut4836egxxxx
7	Evaluation Kit for RA6M5 Microcontroller Group EK-RA6M5 Quick Start Guide / r20qs0021egxxxx
8	Evaluation Kit for RA6M5 Microcontroller Group EK-RA6M5 v1 User's Manual / r20ut4829egxxxx
9	Evaluation Kit for RA8D1 Microcontroller Group EK-RA8D1 Quick Start Guide / r20qs0065egxxxx
10	Evaluation Kit for RA8D1 Microcontroller Group EK-RA8D1 v1 User's Manual / r20ut5205egxxxx
11	Evaluation Kit for RA8M1 Microcontroller Group EK-RA8M1 Quick Start Guide / r20qs0035egxxxx
12	Evaluation Kit for RA8M1 Microcontroller Group EK-RA8M1 v1 User's Manual / r20ut5149egxxxx
13	MCK-RA8T1 Quick Start Guide / r12qs0067ejxxxx
14	MCK-RA8T1 User's Manual / r12uz0133ejxxxx
15	MCK-RA8T2 Quick Start Guide / r12qs0088ejxxxx
16	MCK-RA8T2 User's Manual / r12uz0172ejxxxx
17	Evaluation Kit for RA8D2 Microcontroller Group EK-RA8D2 Quick Start Guide / r20qs0077egxxxx
18	Evaluation Kit for RA8D2 Microcontroller Group EK-RA8D2 v1 User's Manual / r20ut5523egxxxx
19	Evaluation Kit for RA8P1 Microcontroller Group EK-RA8P1 Quick Start Guide / r20qs0051egxxxx
20	Evaluation Kit for RA8P1 Microcontroller Group EK-RA8P1 v1 User's Manual / r20ut5309egxxxx
21	Evaluation Kit for RA8M2 Microcontroller Group EK-RA8M2 Quick Start Guide / r20qs0069egxxxx
22	Evaluation Kit for RA8M2 Microcontroller Group EK-RA8M2 v1 User's Manual / r20ut5451egxxxx

## 2. Features

The Modbus protocol stack for the RA evaluation board enables quick, easy development of Modbus TCP applications.

Modbus function codes supported by the initialization API are also specified. The following nine function codes can be implemented in this stack:

- 1(0x01) – Read coils
- 2(0x02) – Read discrete input
- 3(0x03) – Read holding registers
- 4(0x04) – Read input registers
- 5(0x05) – Write single coil
- 6(0x06) – Write single register
- 15(0x0F) – Write multiple coils
- 16(0x10) – Write multiple registers
- 23(0x17) – Read/Write multiple registers

For more information about Modbus, refer to the following site:

<http://www.modbus.org>

Note: The version number may differ depending on the update. Refer to the latest manual.

### 3. Sample Program Package Configuration

This sample program package consists of three components:

- Modbus sample project using Modbus protocol stack.
- Modbus sample application using Modbus protocol stack.
- Modbus sample demo application

#### 3.1 Modbus Sample Project

- Modbus\_TCP / project / EK-RA6M5
  - This folder contains a folder called "RA\_Modbus" which includes a Modbus sample project for EK-RA6M5 boards that uses the Modbus protocol stack.
  - The sample project is created for GCC compilers. If you want to use another compiler, refer to section "[6.2 Creation of new Modbus Project](#)" and create another project.
  - The sample project is created for EK-RA6M5. If you want to run it on EK-RA6M3, EK-RA6M4, EK-RA8D1, EK-RA8M1, MCK-RA8T1, refer to step (4) of "[6.1 Import Modbus Sample Project](#)" and modify the project with respect to different boards.
- Modbus\_TCP / project / MCK-RA8T2
- Modbus\_TCP / project / EK-RA8D2
- Modbus\_TCP / project / EK-RA8P1
- Modbus\_TCP / project / EK-RA8M2
  - These folders contain a folder called "RA\_Modbus" which includes a Modbus sample project for MCK-RA8T2 / EK-RA8D2 / EK-RA8P1 / EK-RA8M2 boards that uses the Modbus protocol stack.
  - The sample projects are created for GCC compilers. If you want to use another compiler, refer to section "[6.2 Creation of new Modbus Project](#)" and create another project.

#### 3.2 Modbus Sample Application

- Modbus\_TCP / src / modbus\_func.c, modbus\_user.c, new\_thread0\_entry.c
  - User can register their own implementations of Modbus function codes in the Modbus protocol stack.
  - The code in this directory provides examples of the Modbus protocol stack initialization process and the Modbus function codes processing using the Modbus protocol stack API.

#### 3.3 Modbus Demo Application

- Modbus\_tool / ModbusDemoApplication.exe
  - This executable file is a Modbus demo application used for Modbus communication. It can be used to demonstrate the operation of the Modbus sample application.

## 4. Operating Environment Requirements

The sample program package described in this manual runs in the following environment.

**Table 4.1**      **Operating environment**

Item	Description
Board	RA Evaluation Board
Operating Voltage	3.3 V
Integrated Development Environment	IAR Systems <ul style="list-style-type: none"><li>- IAR Embedded Workbench® for Arm Version 9.70.1.13552 or later</li></ul> Renesas Electronics <ul style="list-style-type: none"><li>- e<sup>2</sup> studio 2025-10 or later</li><li>- Renesas RA Smart Configurator 2025-10 or later</li></ul>
Toolchain	IAR Embedded Workbench for Arm <ul style="list-style-type: none"><li>- IAR C/C++ Compiler for Arm 9.70.1.475 (9.70.1.475) or later</li></ul> e <sup>2</sup> Studio <ul style="list-style-type: none"><li>- GCC Arm Embedded (13.2.1.arm-13-7) or later</li><li>- LLVM for Arm (18.1.3) or later</li><li>- Arm Compiler 6.23 or later</li></ul>
MCU Software Package	FSP (Flexible Software Package) v6.2.0 or above
Emulator	J-LINK OB
Communications Protocol	Modbus TCP
Client Tool	ModbusDemoApplication.exe: Modbus Demo Application



## 5. Evaluation Board Connection Setup

Connect the PC to a supported evaluation board. Power is supplied by connecting a USB micro-B cable to the board. For Modbus TCP communication, use an RJ45 connector and connect to the PC with a LAN cable.

The connection setting diagrams for the EK RA8M1 evaluation board, the MCK-RA8T1 board and the MCK-RA8T2 board are shown below.

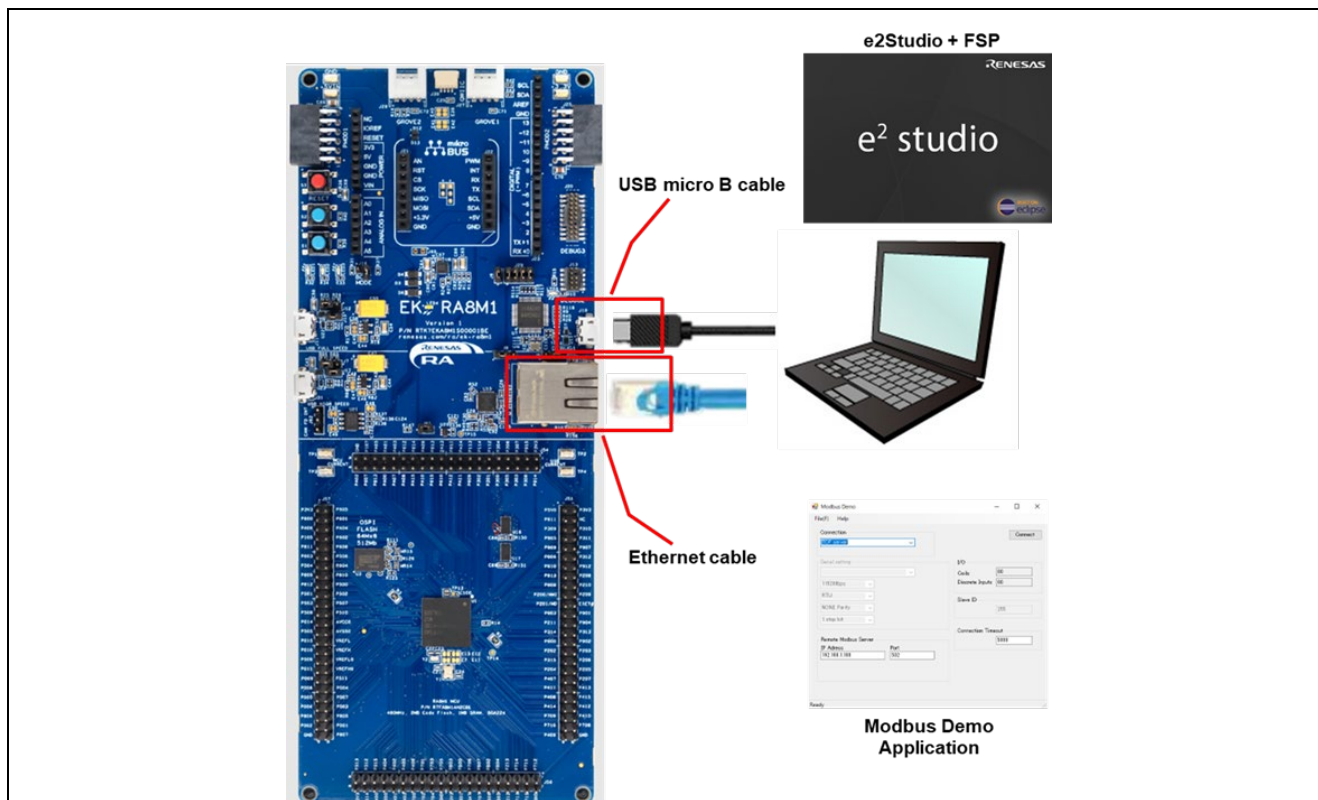


Figure 5.1. EK evaluation board connection setup for RA (Example: EK-RA8M1)

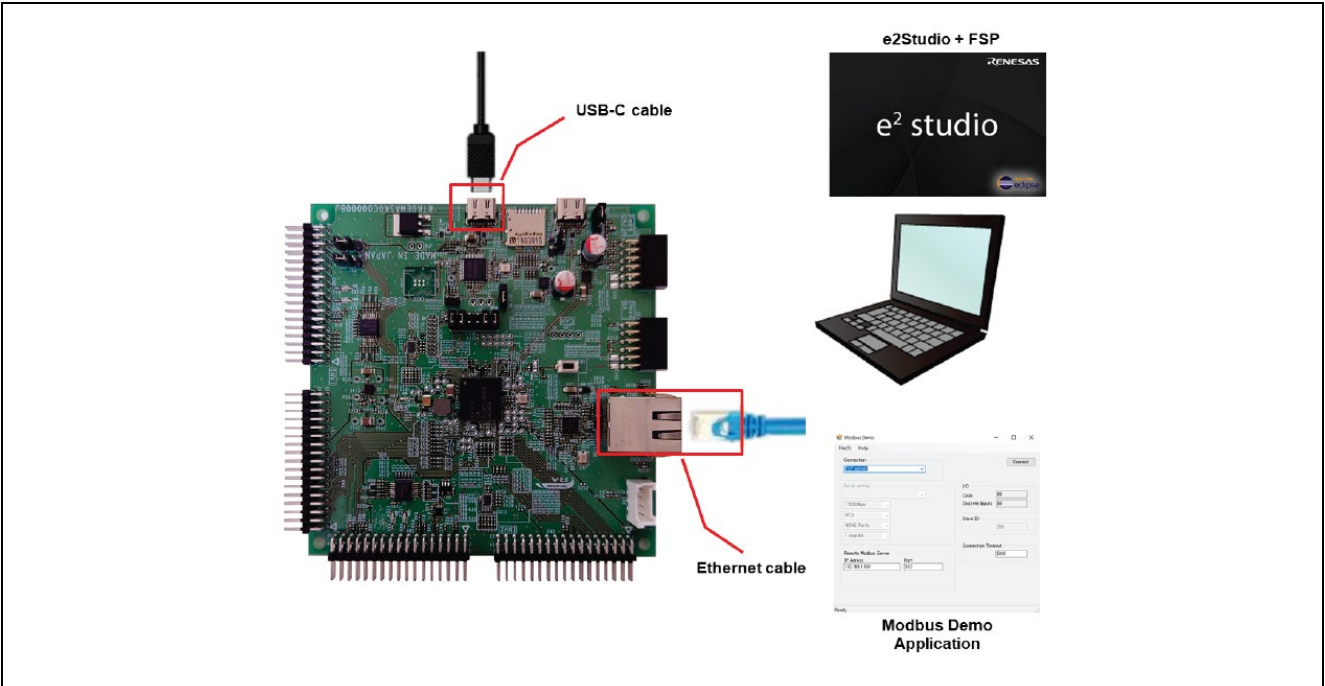


Figure 5.2. MCK-RA8T1 board connection setup

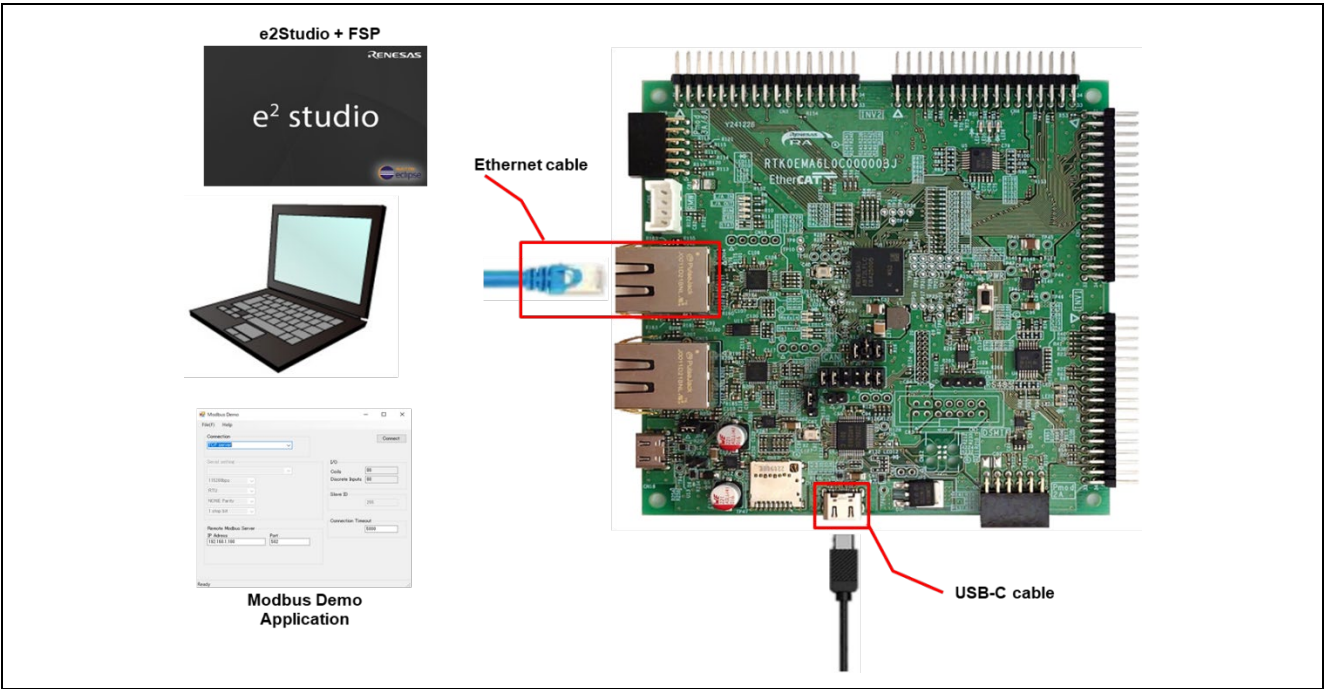


Figure 5.3. MCK-RA8T2 board connection setup

## 6. Setting Up the Modbus Sample Project

This section describes the procedure for importing/creating a Modbus sample project. Before this, read section "4. Operating Environment Requirements" first and complete the installation of the tools.

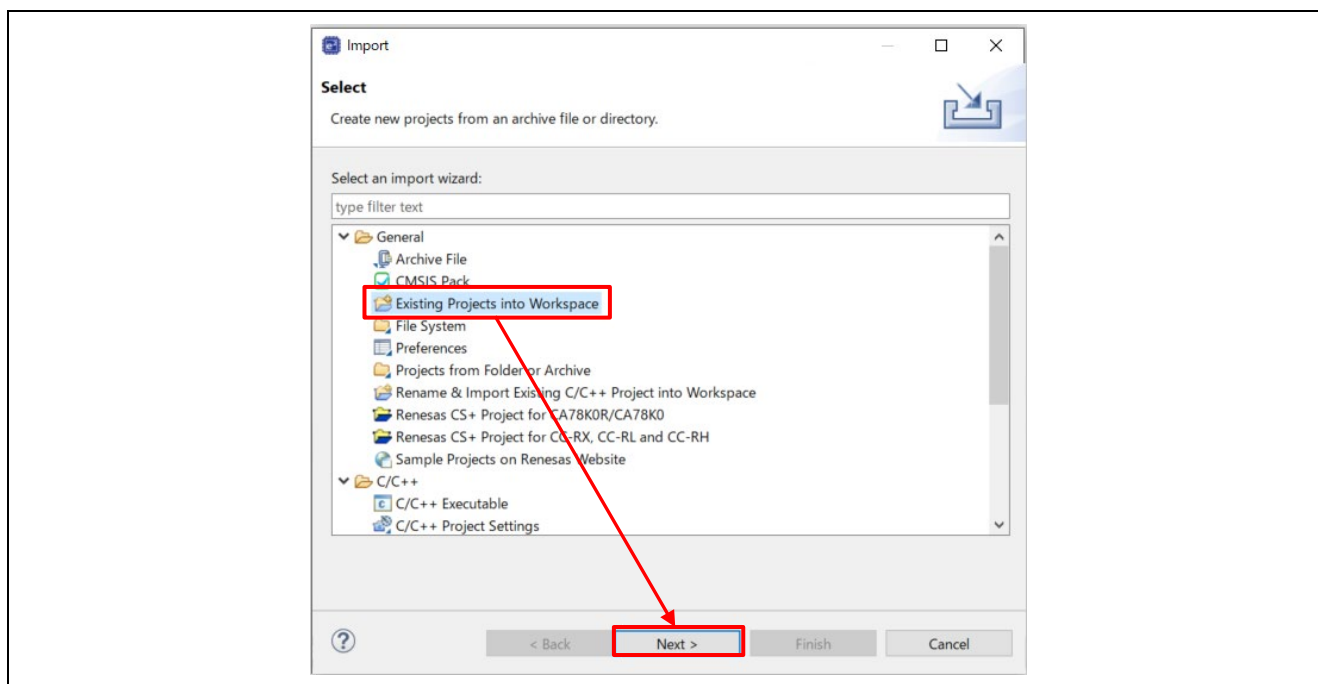
### 6.1 Import Modbus Sample Project

This section describes the procedure for importing the Modbus sample project and changing the evaluation board.

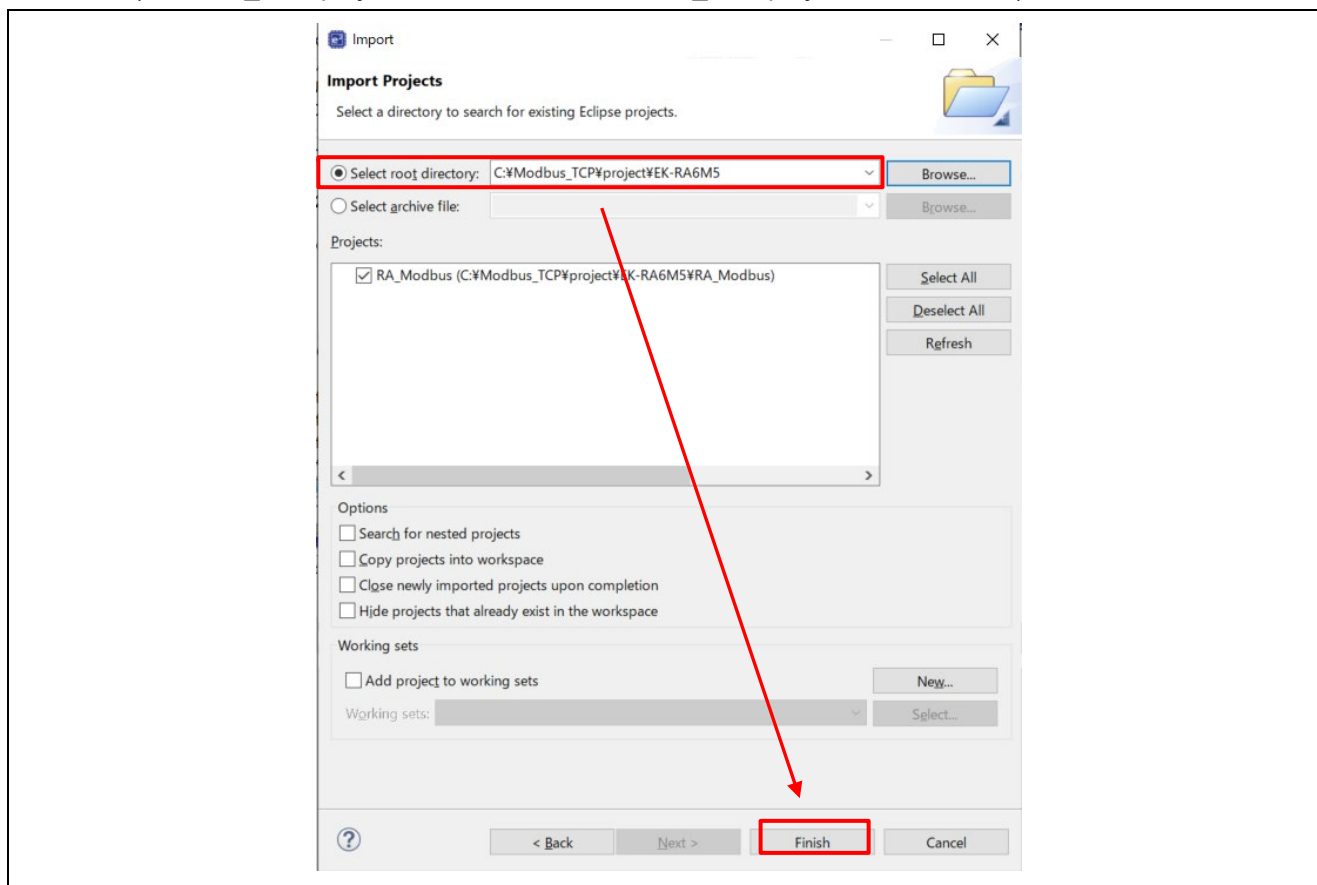
#### 6.1.1 EK-RA6Mx / EK-RA8x1 / MCK-RA8T1 Importing Procedures

This section describes the procedures for importing EK-RA6Mx (EK-RA6M3, EK-RA6M4, EK-RA6M5) / EK-RA8x1 (EK-RA8D1, EK-RA8M1) / MCK-RA8T1.

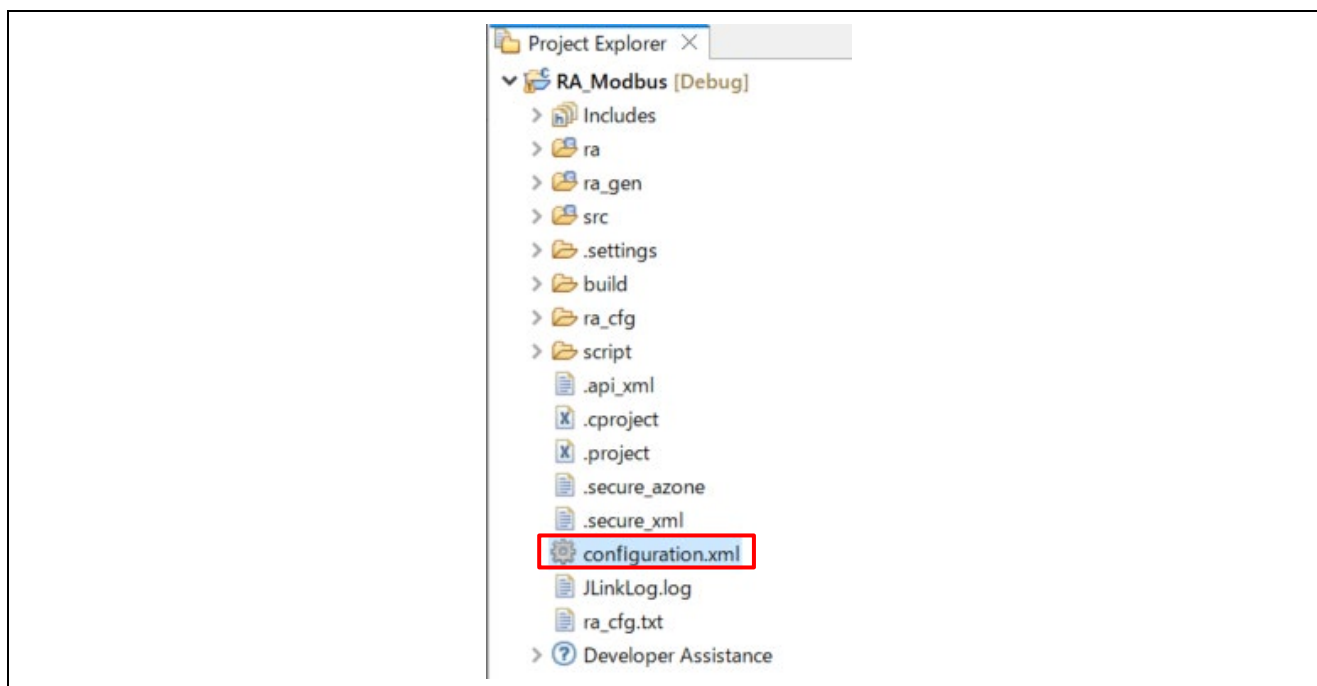
1. Import the sample project. Start e<sup>2</sup> studio, select [File] → [Import], and when the Import window appears, select [General] → [Existing Projects into Workspace].



Check "select root directory" and select the Modbus sample project folder ("Modbus\_TCP/project/EK-RA6M5" or "Modbus\_TCP/project/MCK-RA8T2").

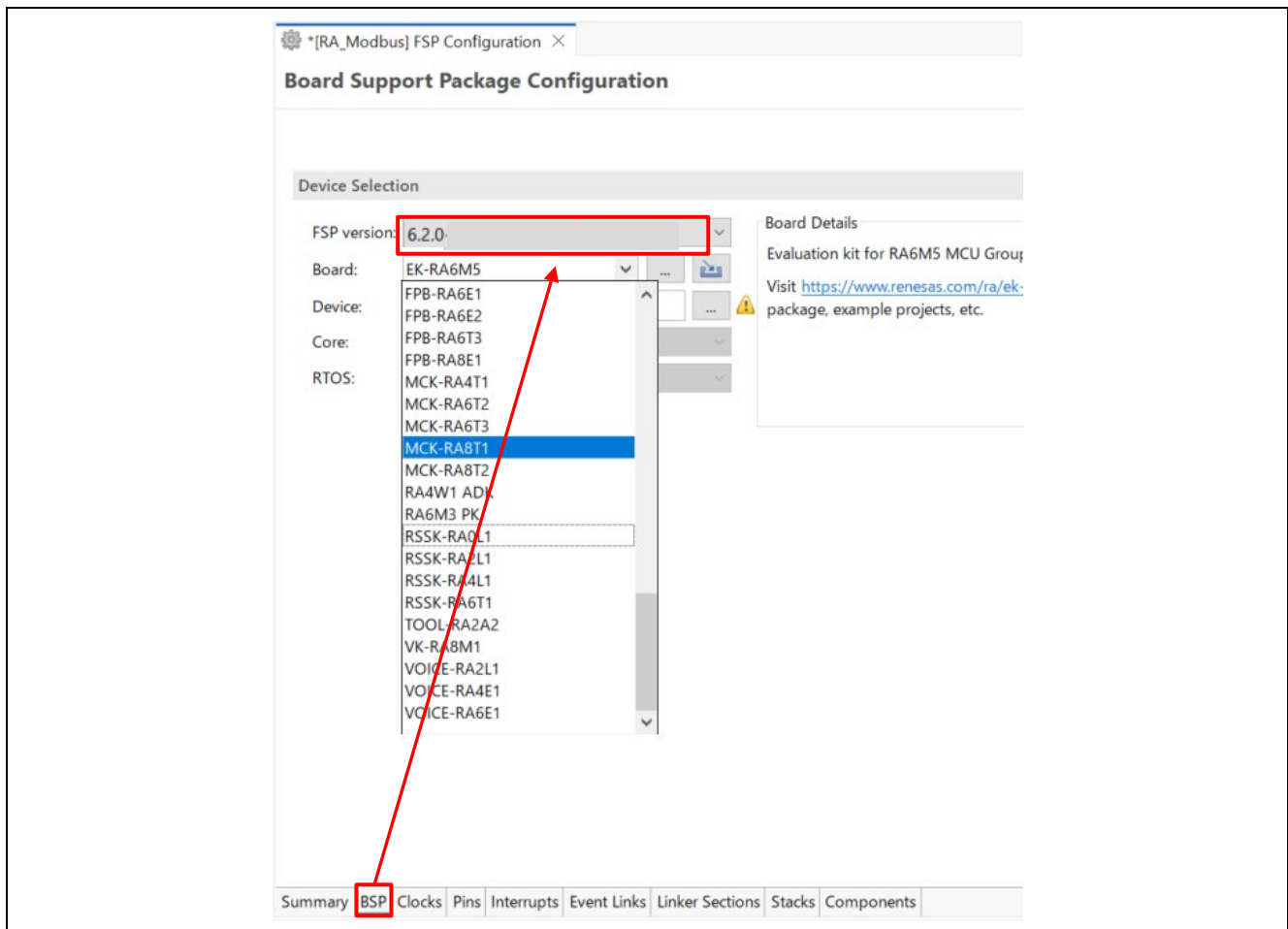


2. Open "configuration.xml" of "RA\_Modbus" project.

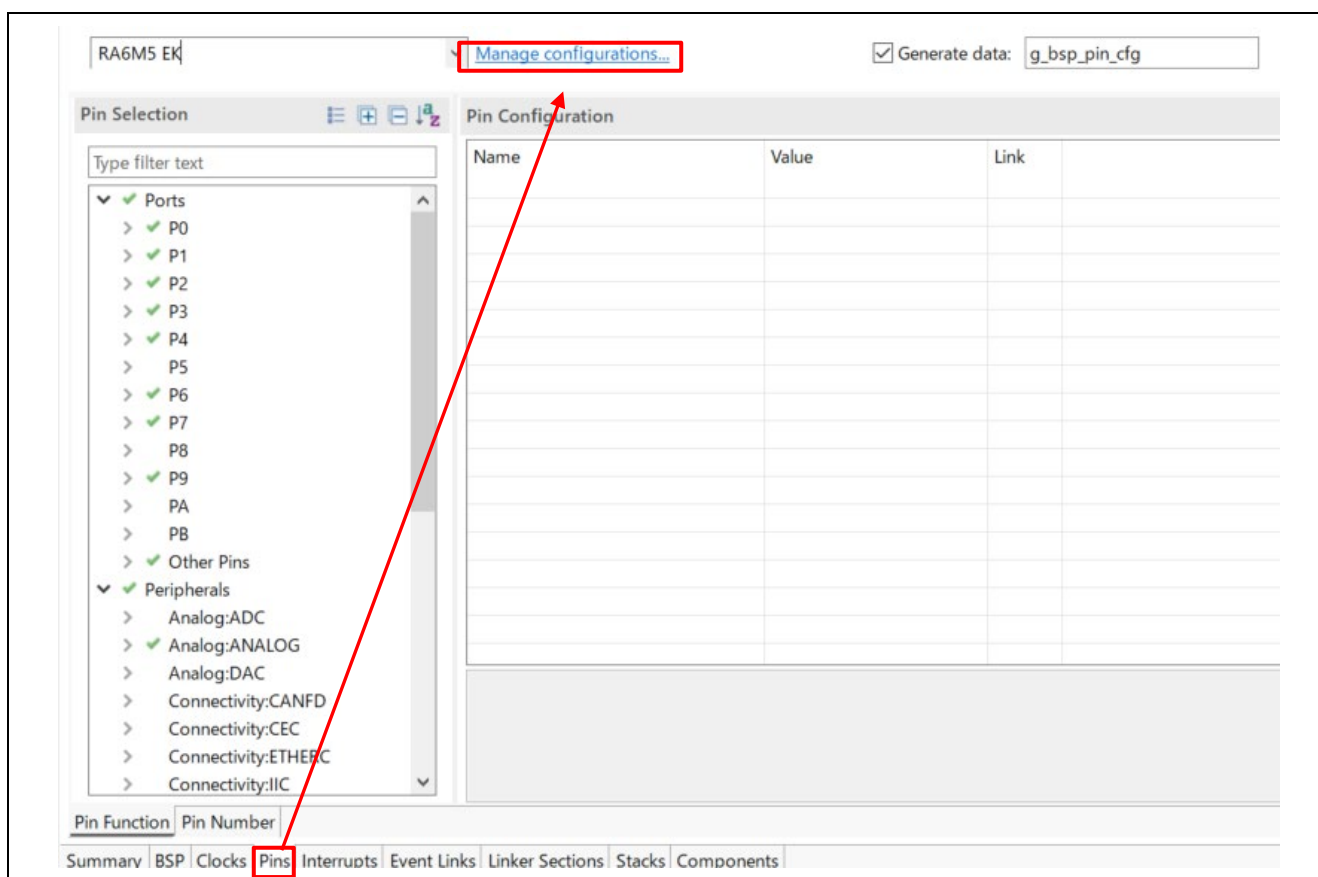


3. The "RA\_Modbus" project under the "Modbus\_TCP/project/EK-RA6M5" folder is created for EK-RA6M5. To run it on another supported evaluation board, modify the project by following the steps (1) to (4) below.

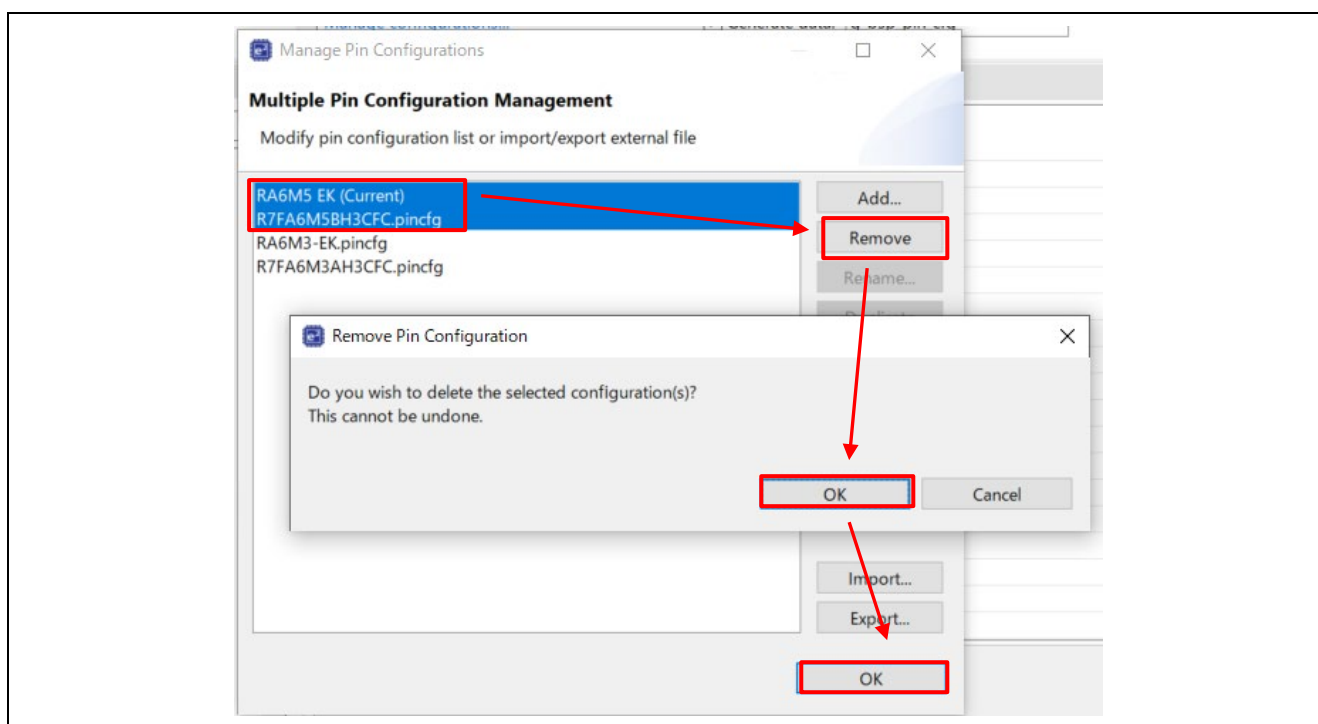
- (1) Click the "BSP" tab, then select "EK-RA6M3", "EK-RA6M4", "EK-RA8D1", "EK-RA8M1", or "MCK-RA8T1" from "Board".



- (2) Click "Manage Configurations" on the "Pins" tab

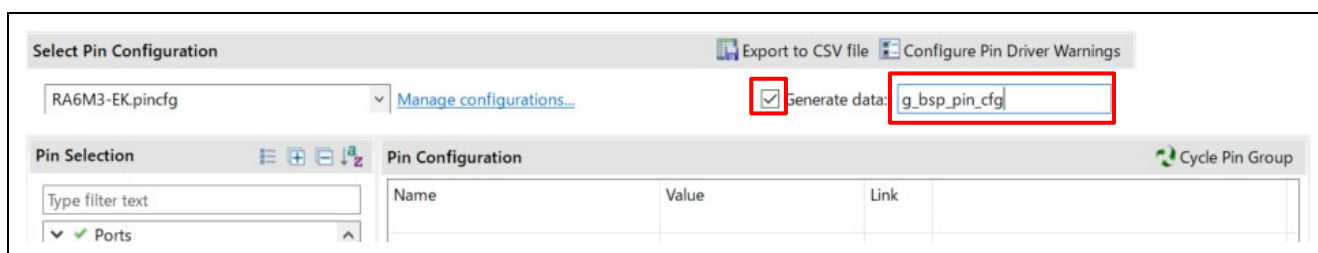


- (3) Select "RA6M5 EK (Current)" and "R7FA6M5BH3CFC.pincfg" and click "Remove". Click "OK" in the "Remove Pin Configuration" pop-up, then click "OK" in "Manage Pin Configurations".



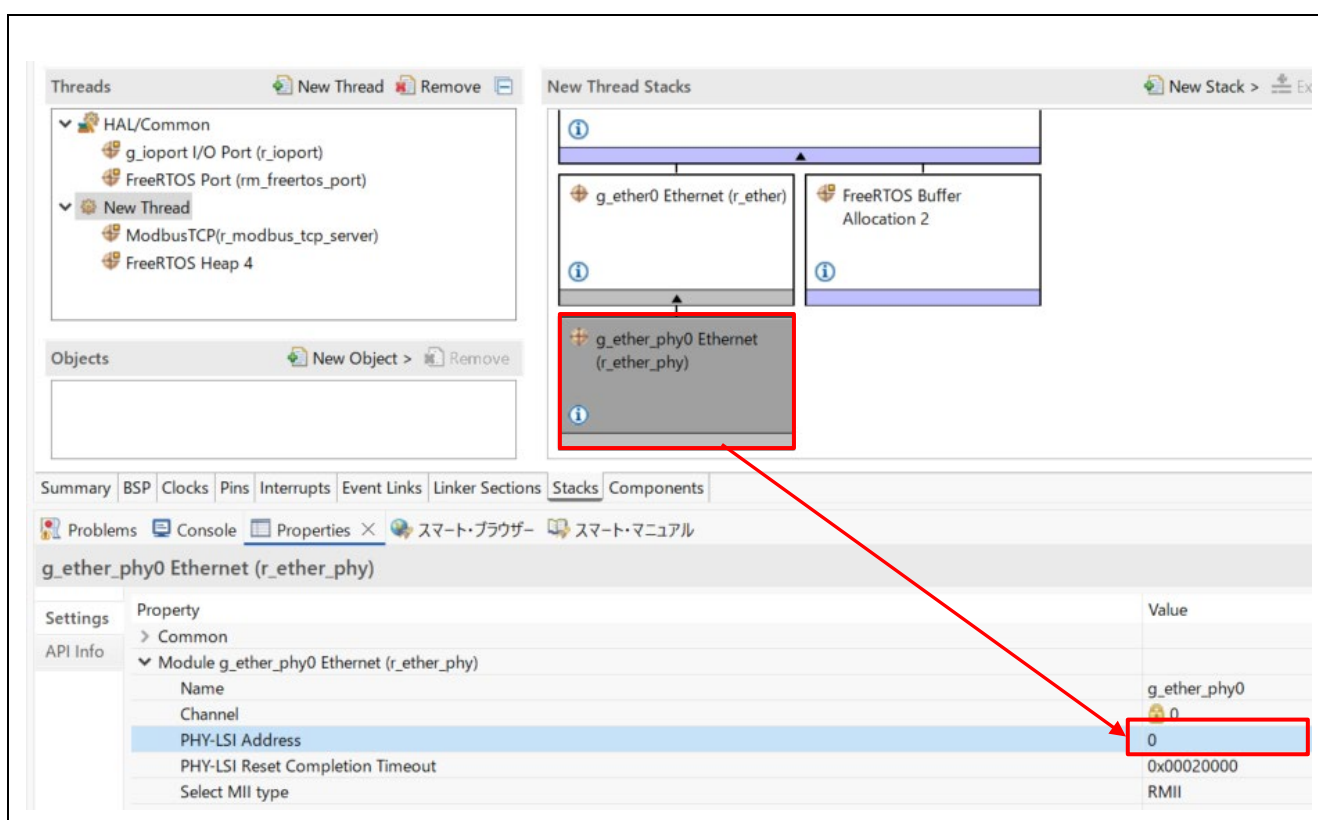


- (4) Check the "Generate data" checkbox and enter "g\_bsp\_pin\_cfg" in the text box.



4. For "EK-RA8D1", "EK-RA8M1" and "MCK-RA8T1", change "PHY-LSI Address" in "Stacks" → "g\_ether\_phy0 Ethernet (r\_ether\_phy)" → "Module g\_ether\_phy0 Ethernet (r\_ether\_phy)" to the following value.

PHY-LSI Address: **5**



5. For "EK-RA8D1" and "MCK-RA8T1", click the "Pins" tab, then select Reset pin [Reset Pin for each evaluation board] (see below), go to "Pin Configuration" and change the "Mode" to "Disabled".

EK-RA8D1: **P706**, MCK-RA8T1: **PB01**

The screenshot displays the Renesas RA Pin Configuration tool interface. On the left, the "Pin Selection" pane shows a tree view of pins. Under the "PB" port, pin "PB01" is selected and highlighted with a red box. A red arrow points from this box to the "Mode" field in the "Pin Configuration" pane on the right. In the "Pin Configuration" pane, the "Mode" field is set to "Disabled" and is also highlighted with a red box. Below the "Pin Configuration" pane, the "Module name" is "PB01" and "Port Capabilities" are listed as "BUS: ALE" and "SCI1: CTS RTS1". At the bottom, a tabbed interface shows the "Pins" tab selected, with other tabs like "Summary", "BSP", "Clocks", "Interrupts", "Event Links", "Linker Sections", "Stacks", and "Components".

Name	Value	Link
Symbolic Name	ETHER_RESETN	
Comment		
Mode	Disabled	
Pull up/down	None	
Output Type	CMOS	
Drive Capacity	L	
Input/Output		
PB01	None	

Module name: PB01  
Port Capabilities: BUS: ALE  
SCI1: CTS RTS1

Pin Function: Pin Number

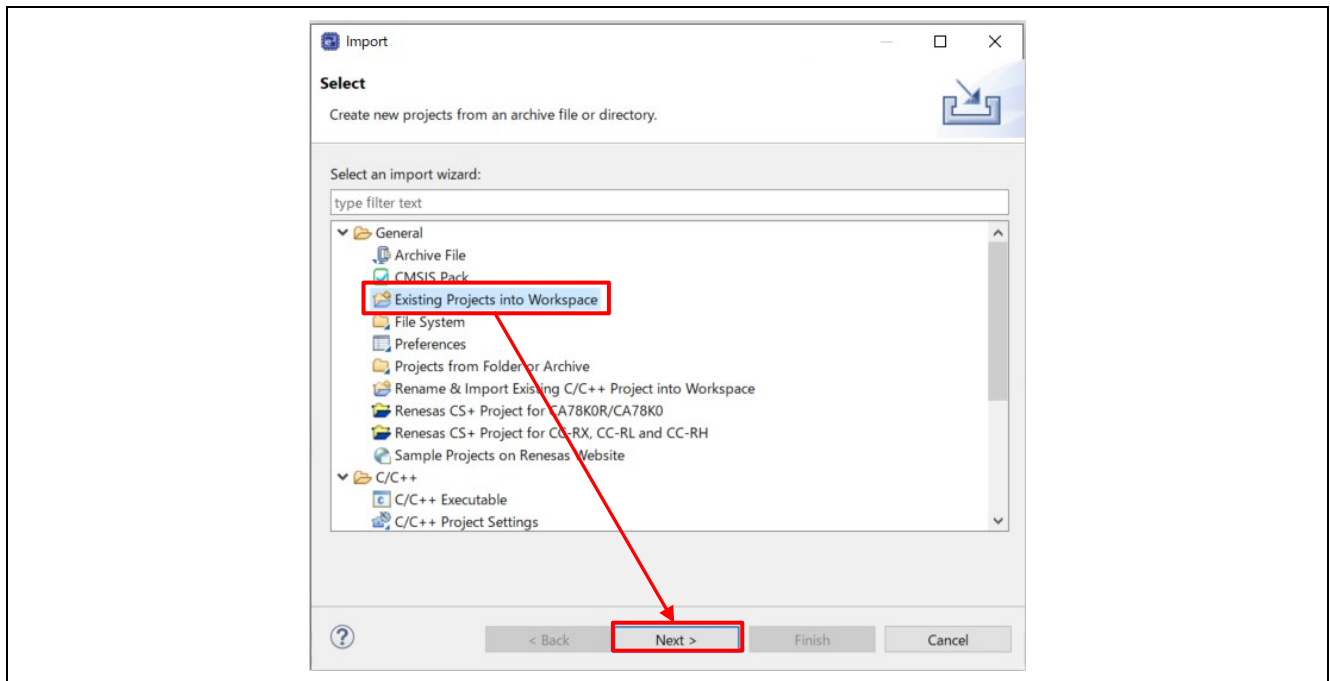
Summary | BSP | Clocks | Pins | Interrupts | Event Links | Linker Sections | Stacks | Components



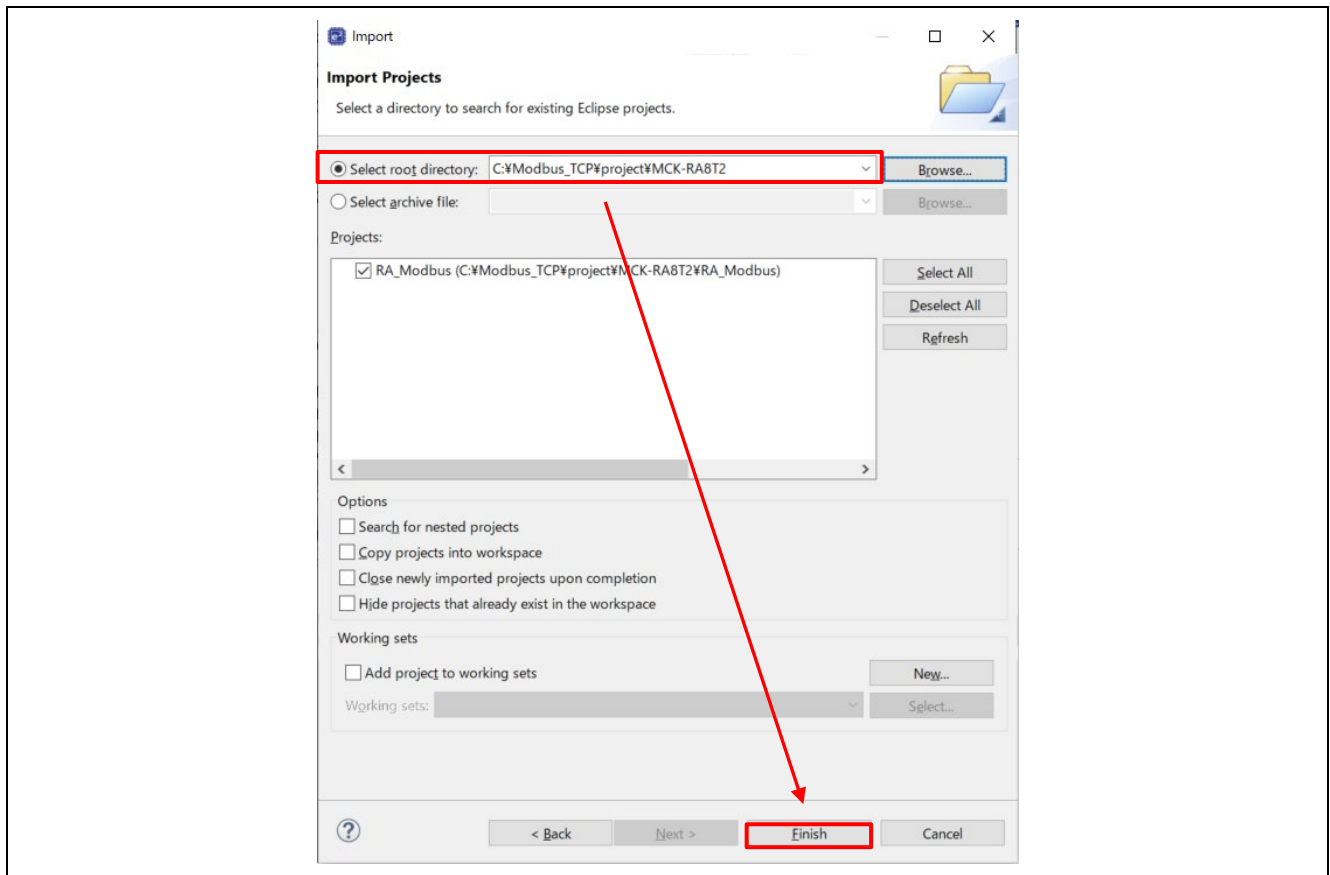
### 6.1.2 MCK-RA8T2 / EK-RA8D2 / EK-RA8P1 / EK-RA8M2 Importing Procedures

This section describes the procedures for importing MCK-RA8T2 / EK-RA8D2 / EK-RA8P1 / EK-RA8M2.

1. Import the sample project. Start e<sup>2</sup> studio, select [File] → [Import], and when the Import window appears, select [General] → [Existing Projects into Workspace].



Check "select root directory" and select the Modbus sample project folder ("Modbus\_TCP/project/[evaluation board]").



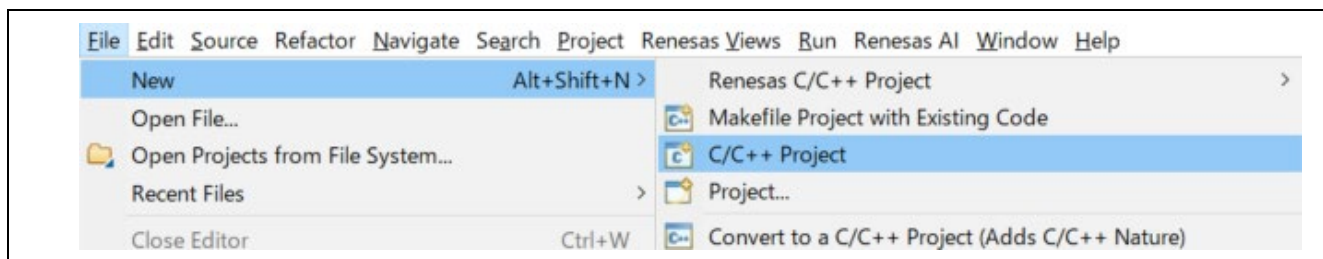
## 6.2 Creation of a new Modbus Project

This section describes the procedure for creating a new Modbus sample project.

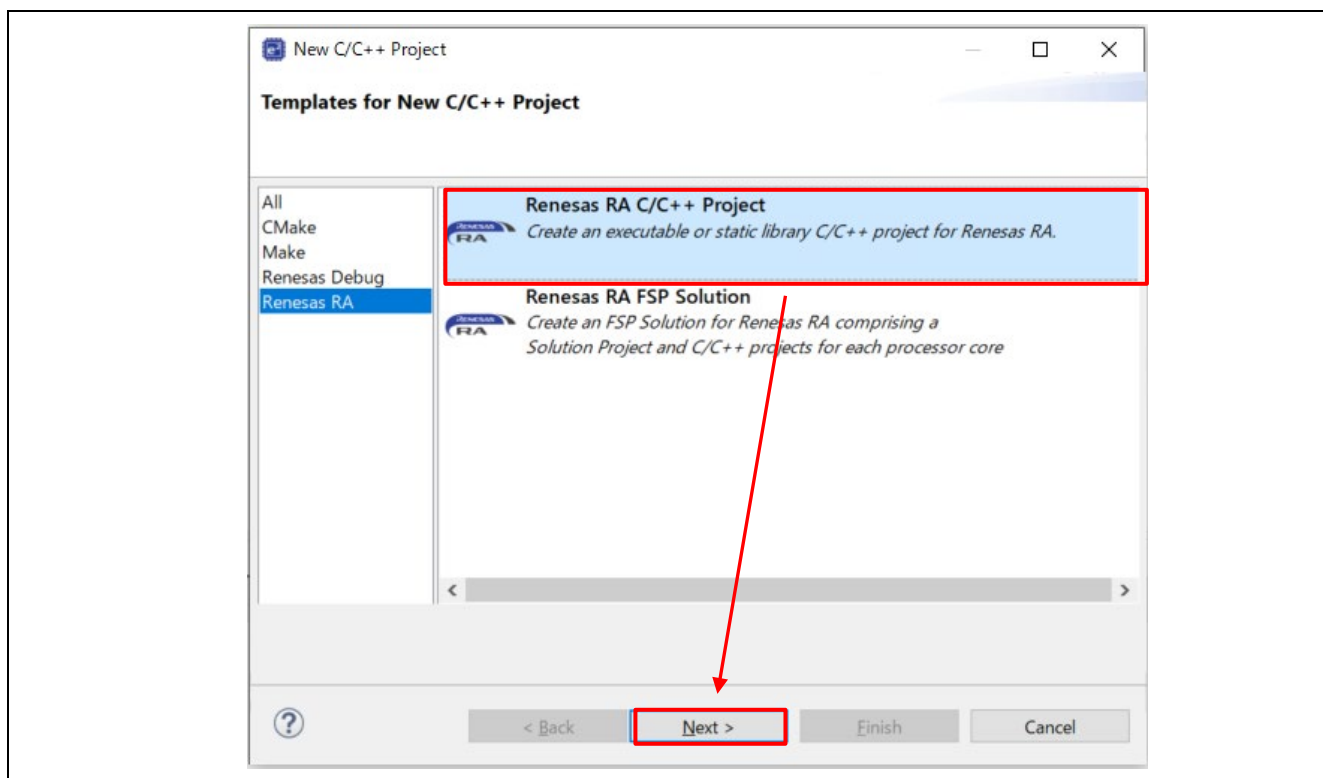
### 6.2.1 Common procedures for all evaluation boards

This section describes the procedures common to all evaluation boards.

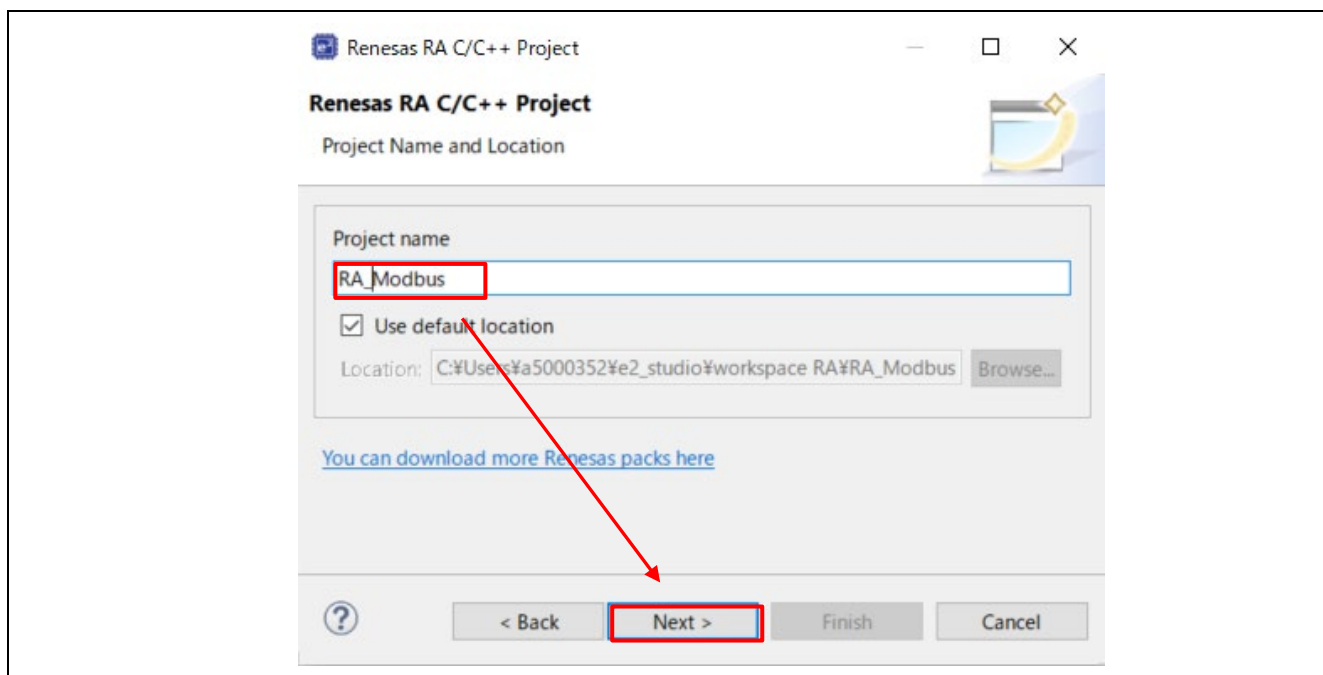
1. Set up a new project. Start e<sup>2</sup> studio and select [File] → [New] → [C/C++ Project].



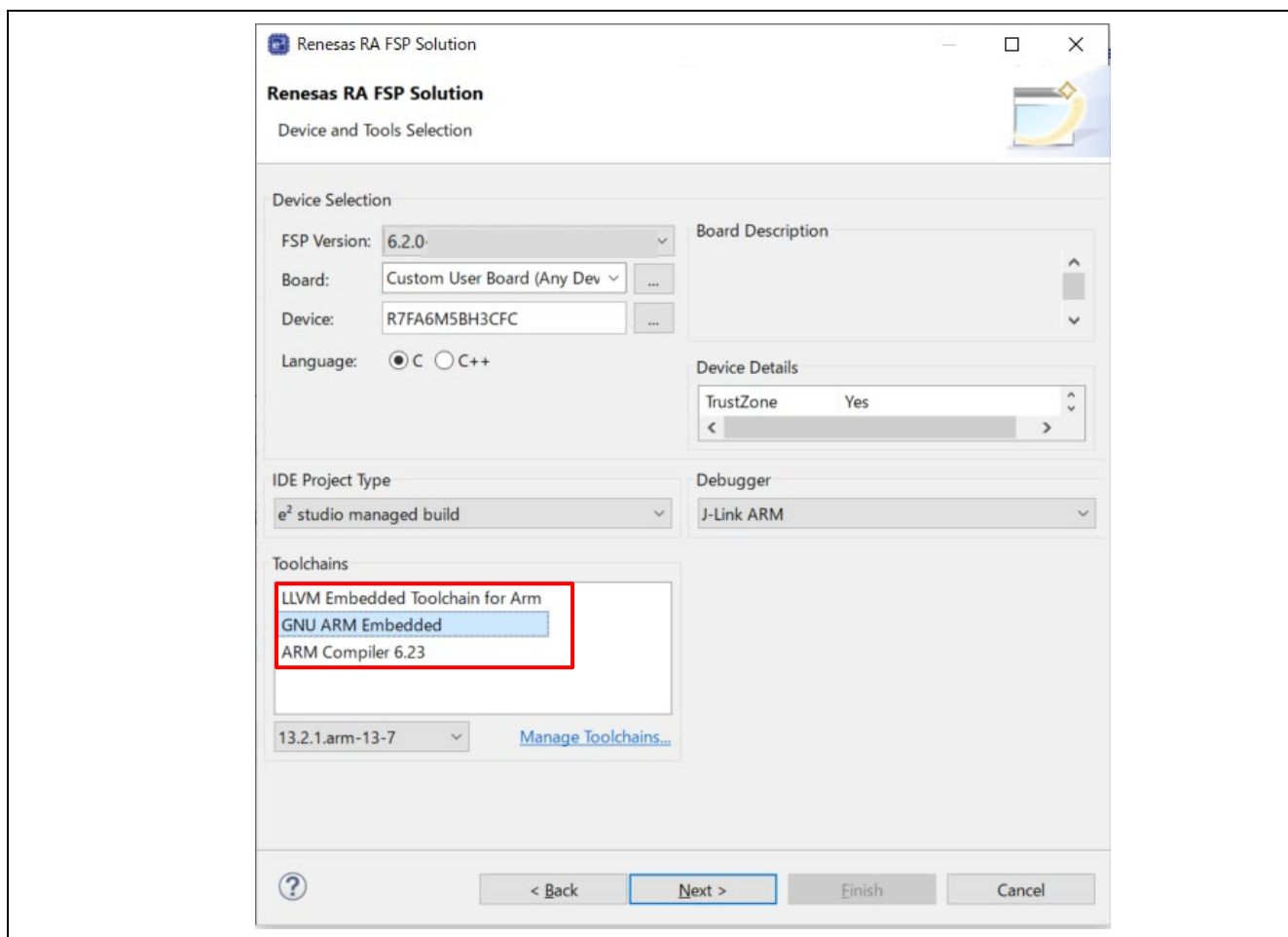
2. Select "Renesas RA C/C++ Project"



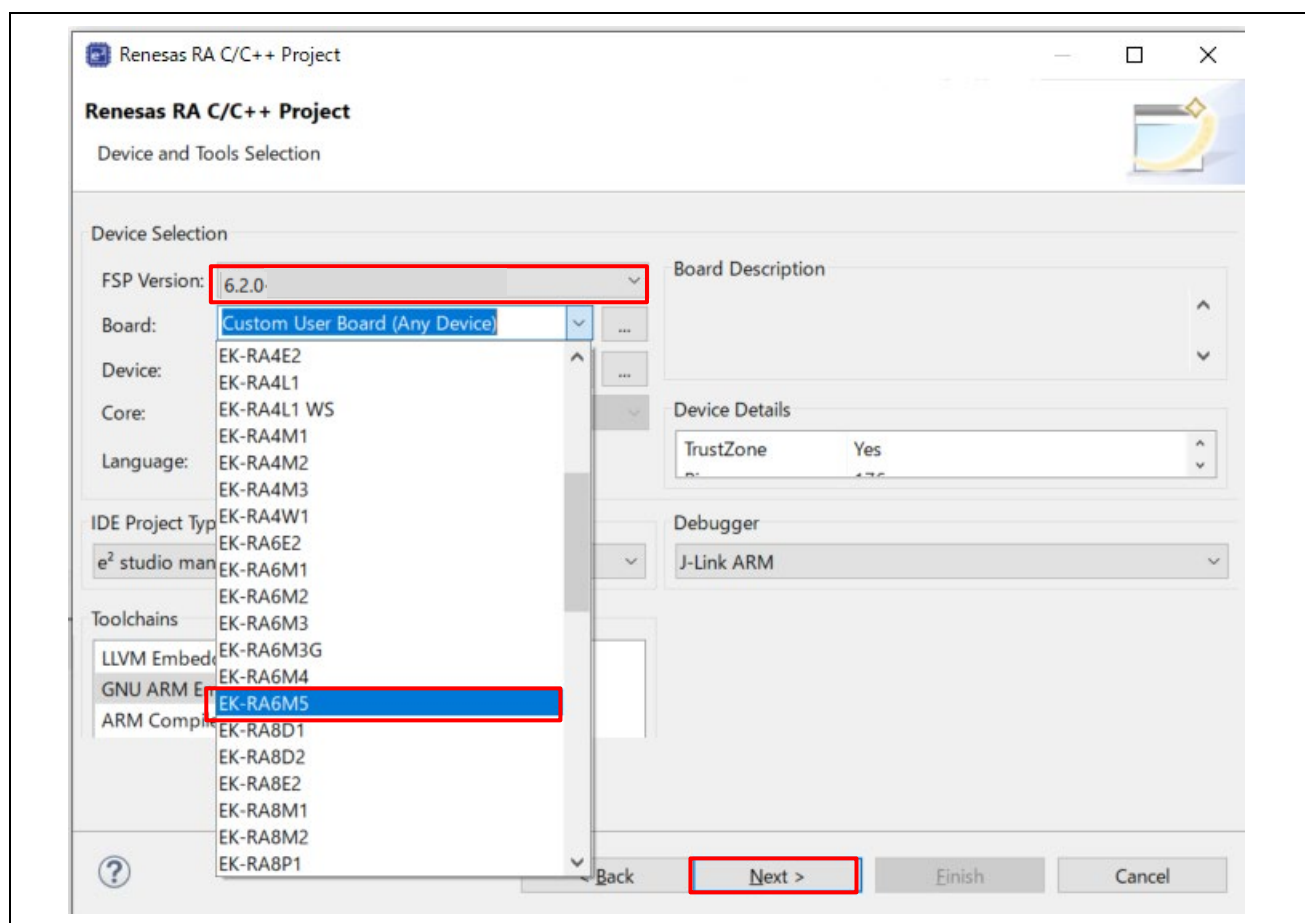
3. Enter any project name.



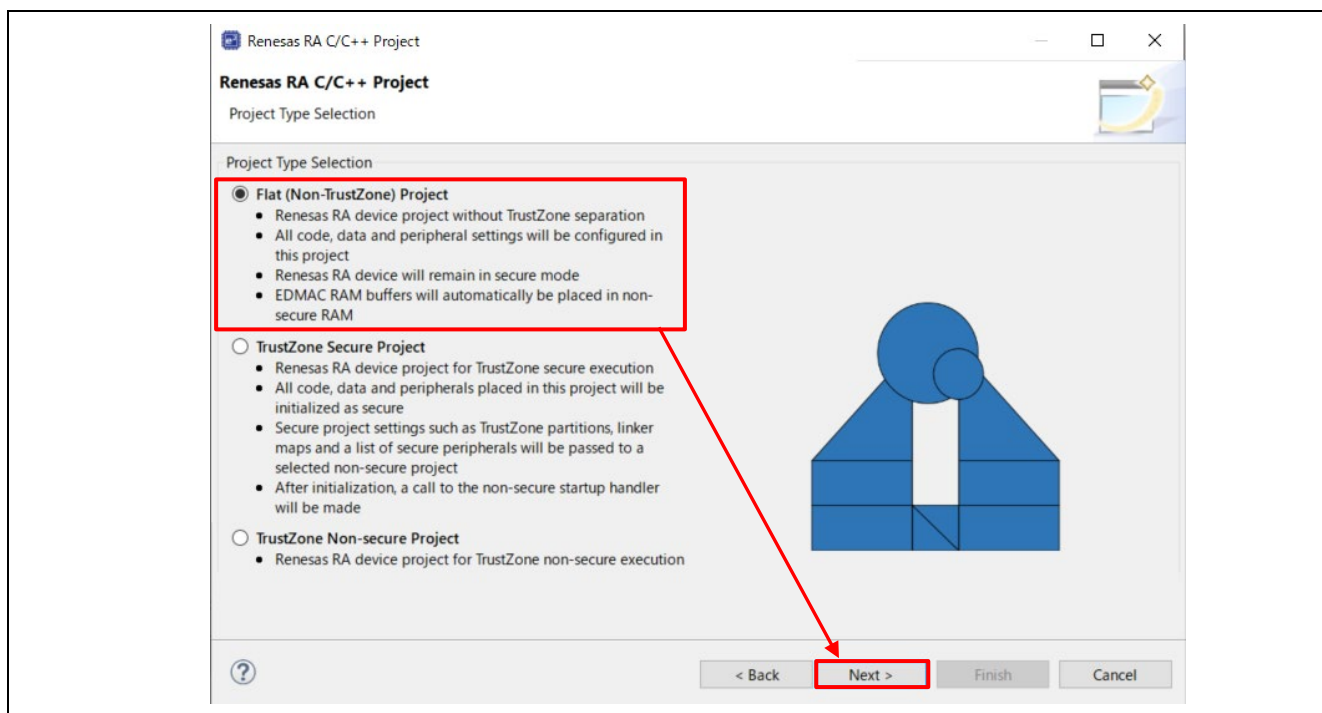
4. Select "Toolchains"



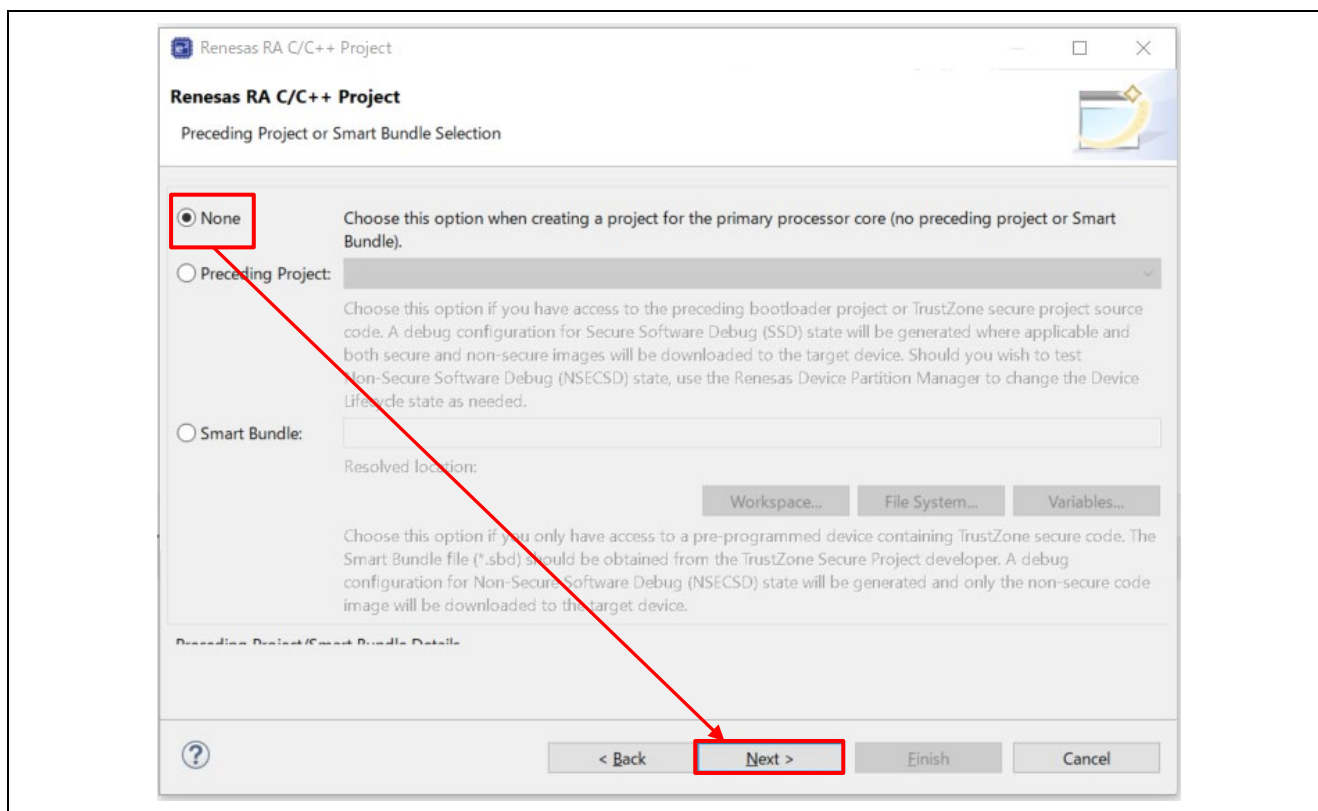
## 5. Select the FSP Version and Board



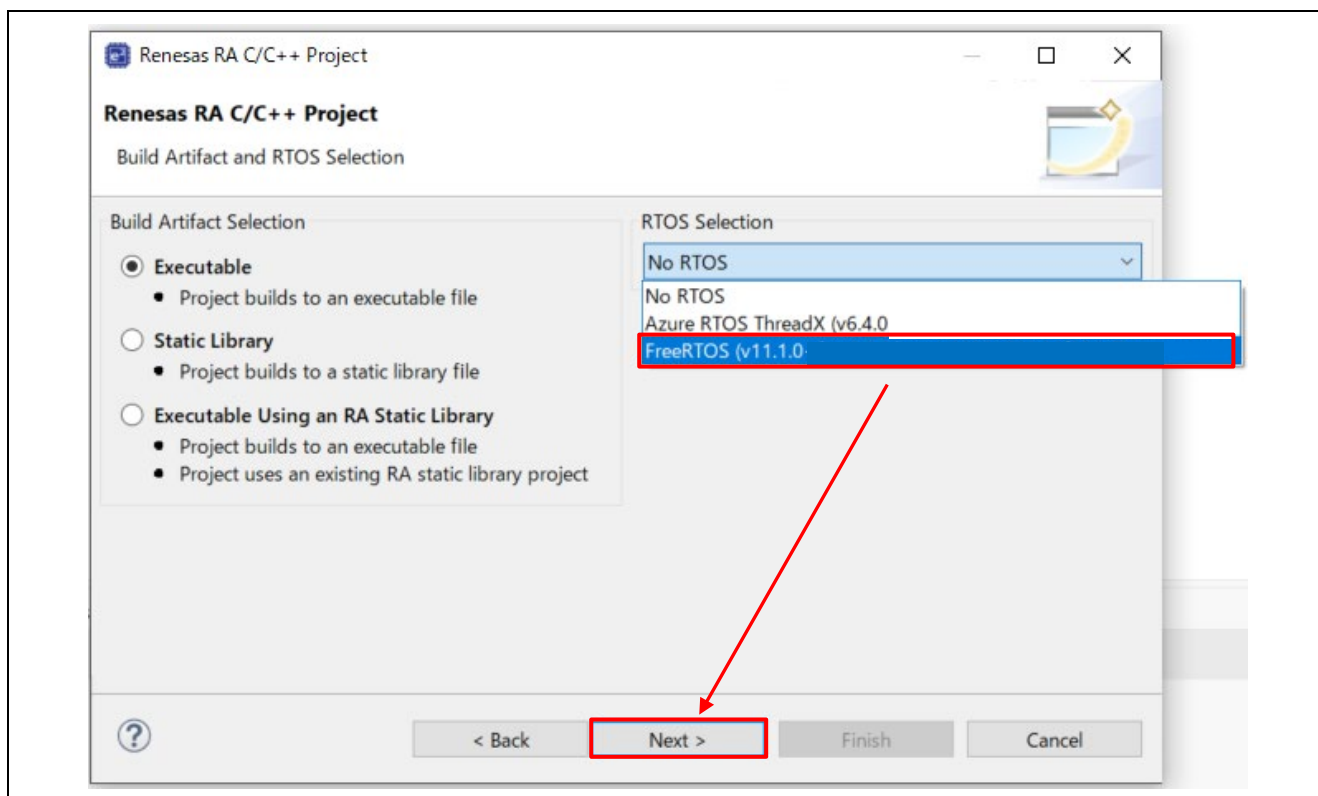
## 6. Select the project type for "Flat (Non-TrustZone) Project"



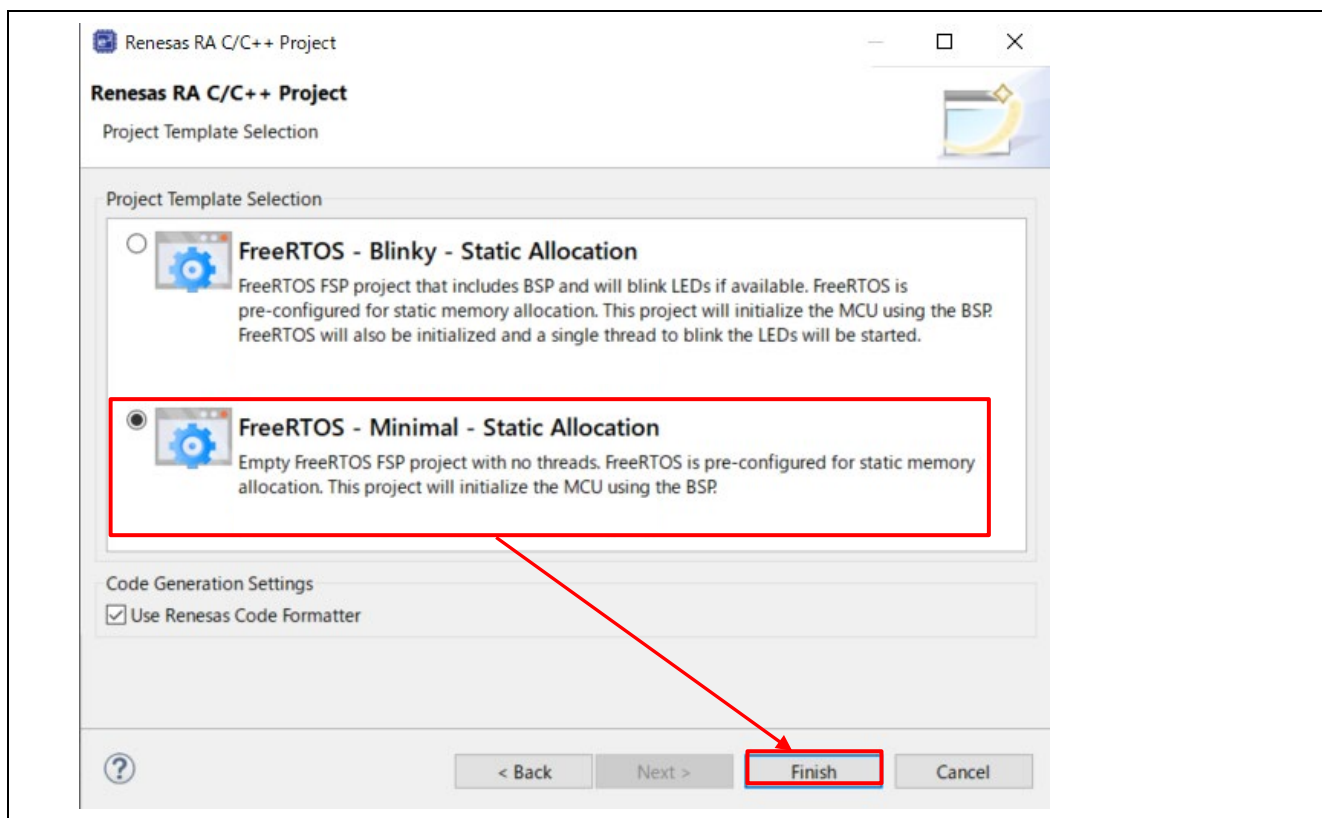
## 7. Select "None"



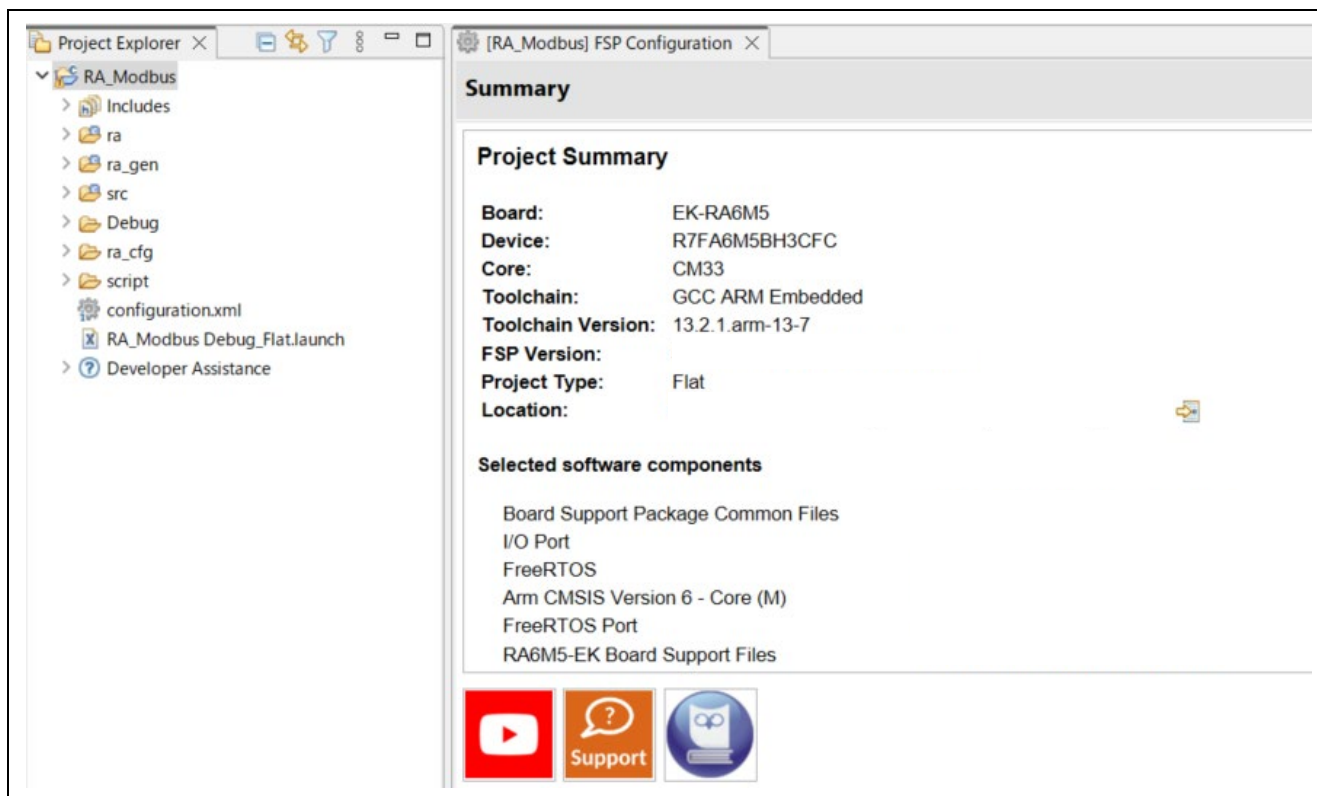
## 8. Select "FreeRTOS (xxx)".



9. Select “FreeRTOS - Minimal - Static Allocation” under Project Template Selection.



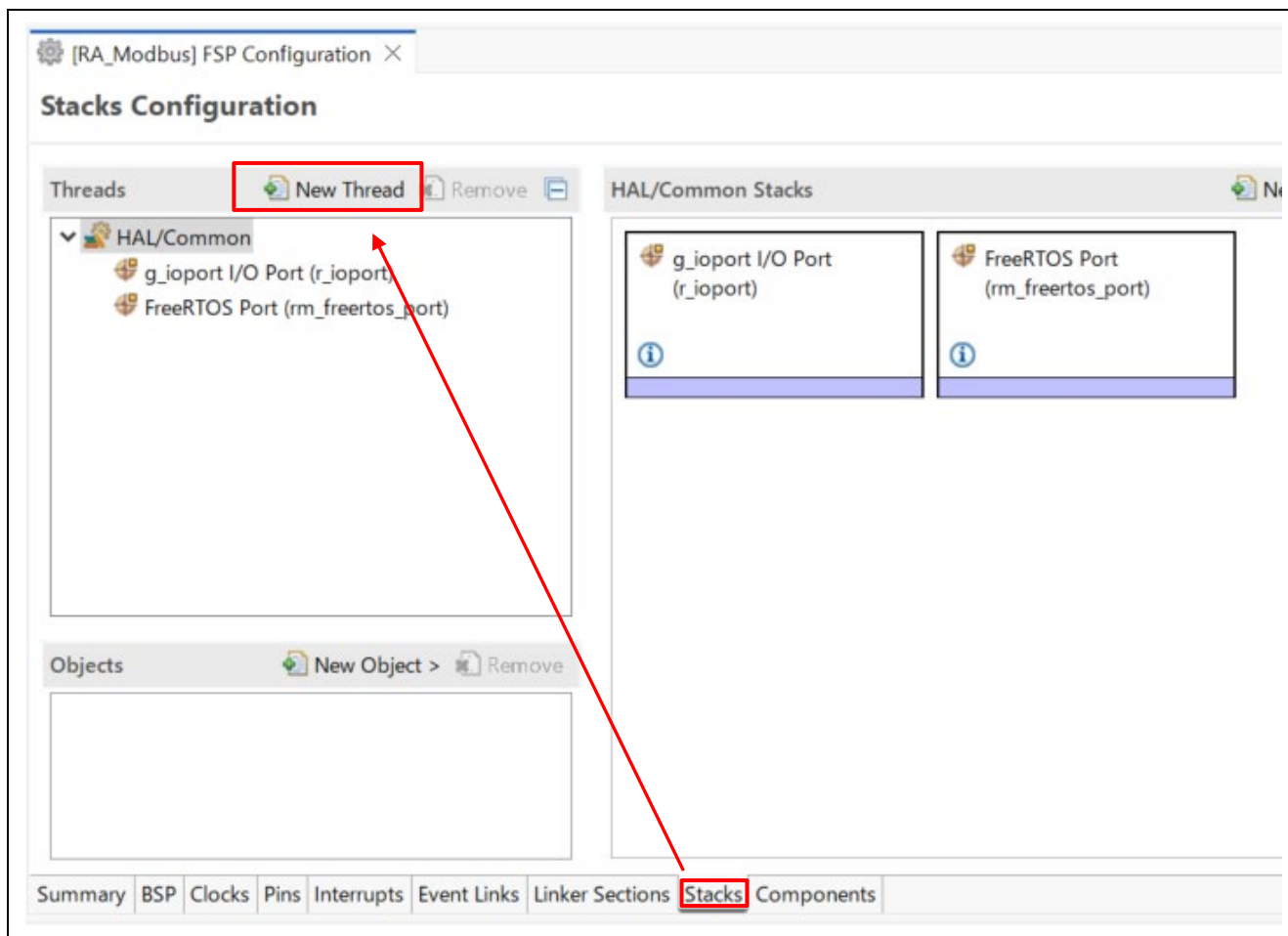
Once the project is created, it will appear in the “Project Explorer,” and the “FSP Configuration” tab will be displayed.





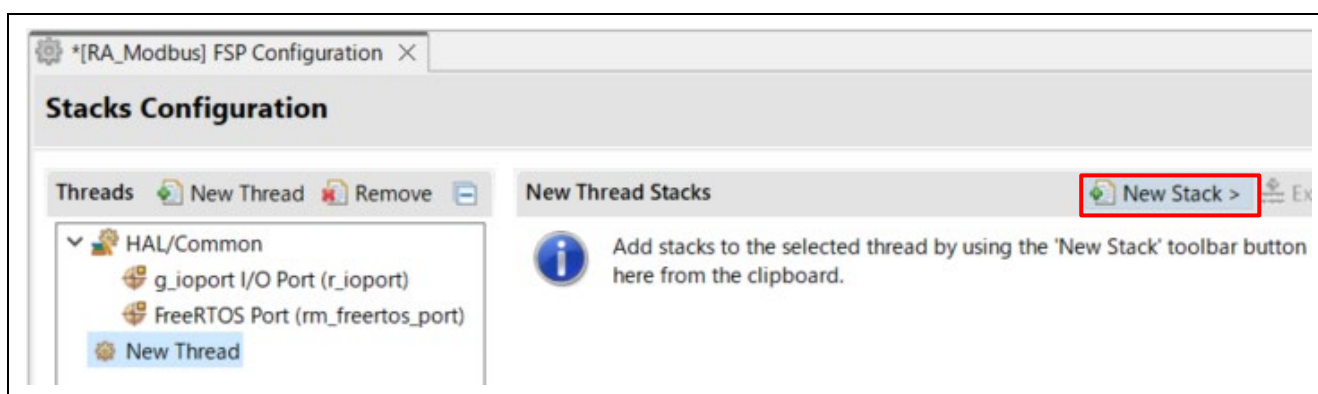
## 10. Create New Thread

In the "FSP Configuration", click the "Stacks" tab, select "Threads" → "New Thread". A new thread will appear.



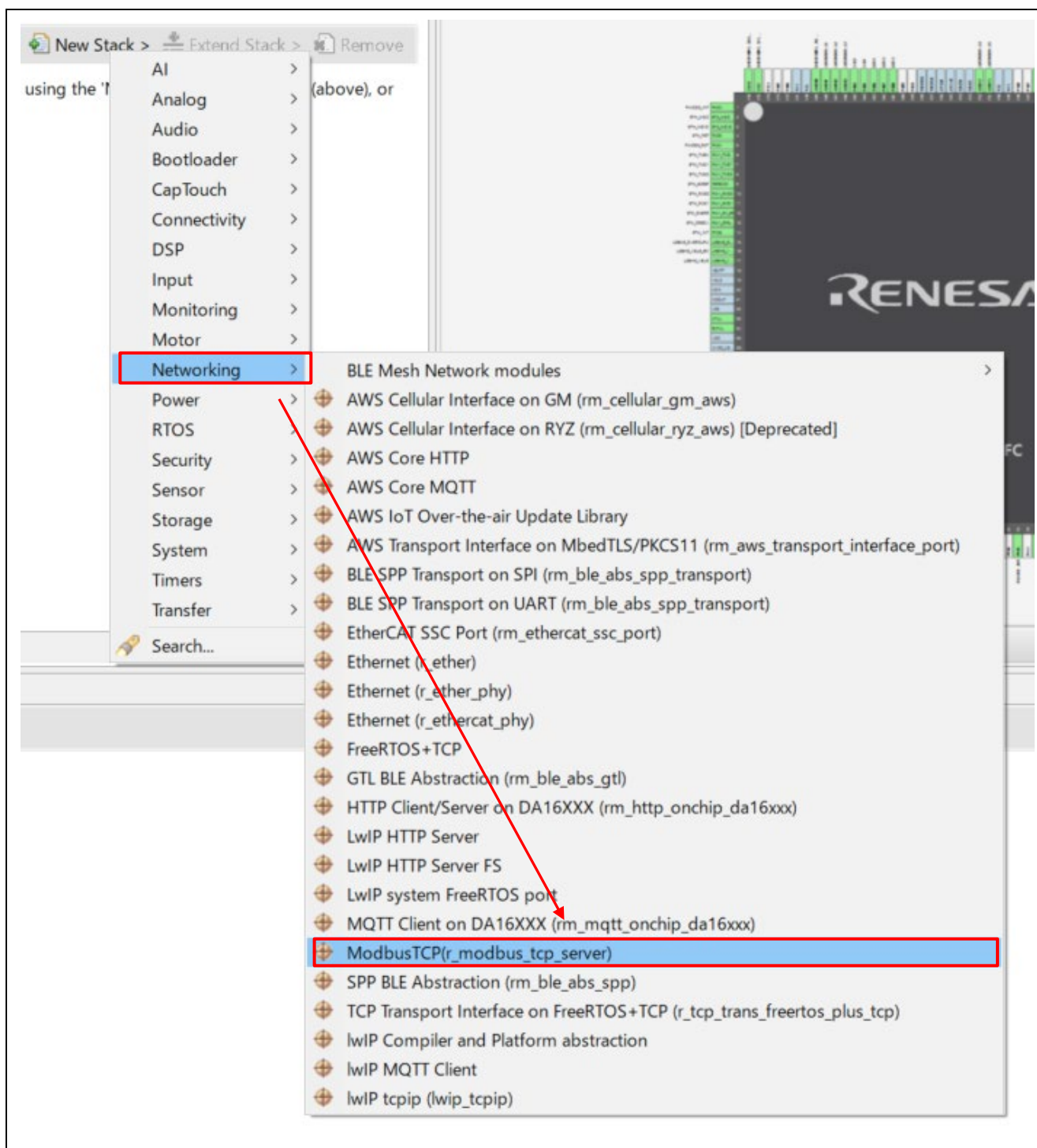
## 11. Create New Stack

Select "New Stacks" to be configured.

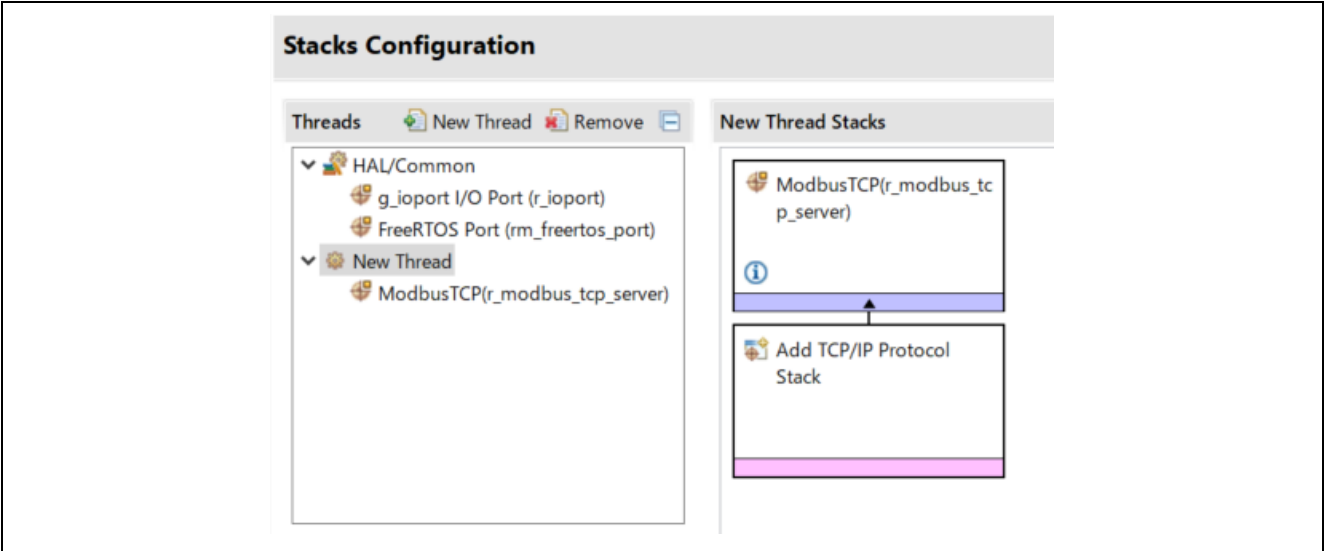




Select “Networking” → ” Modbus TCP Server (r\_modbus\_tcp\_server)”.



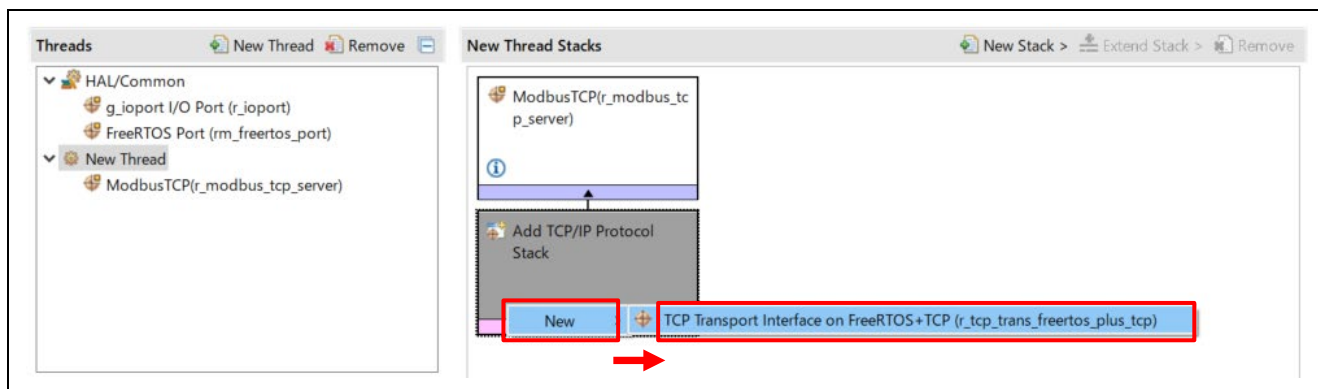
The stack is configured as follows:



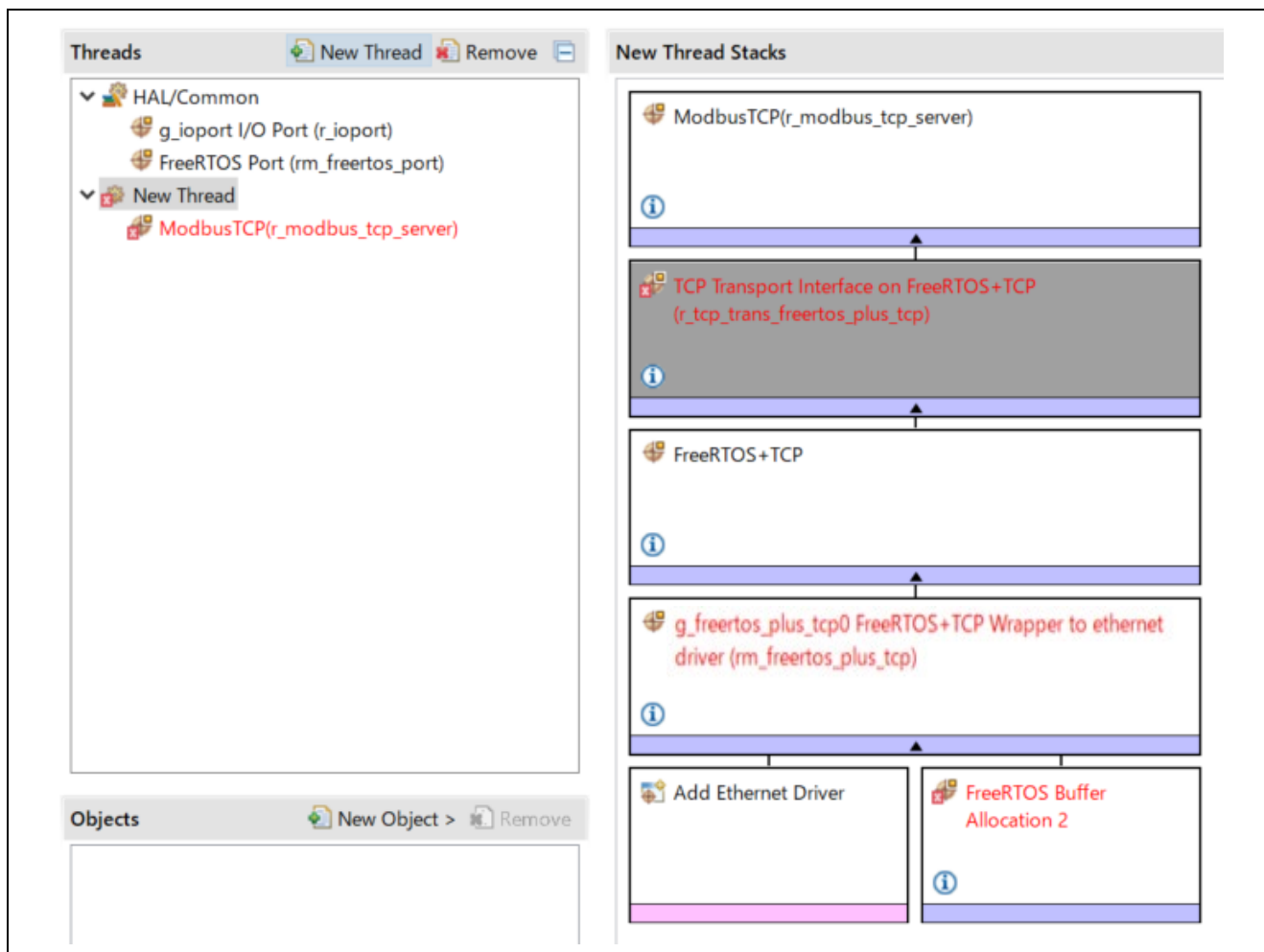
## 12. Add FreeRTOS+TCP

Click “New” → “TCP Transport Interface on FreeRTOS+TCP

(r\_modbus\_tcp\_server\_port\_freertos\_plus\_tcp)” to “Add TCP/IP Protocol Stack”.

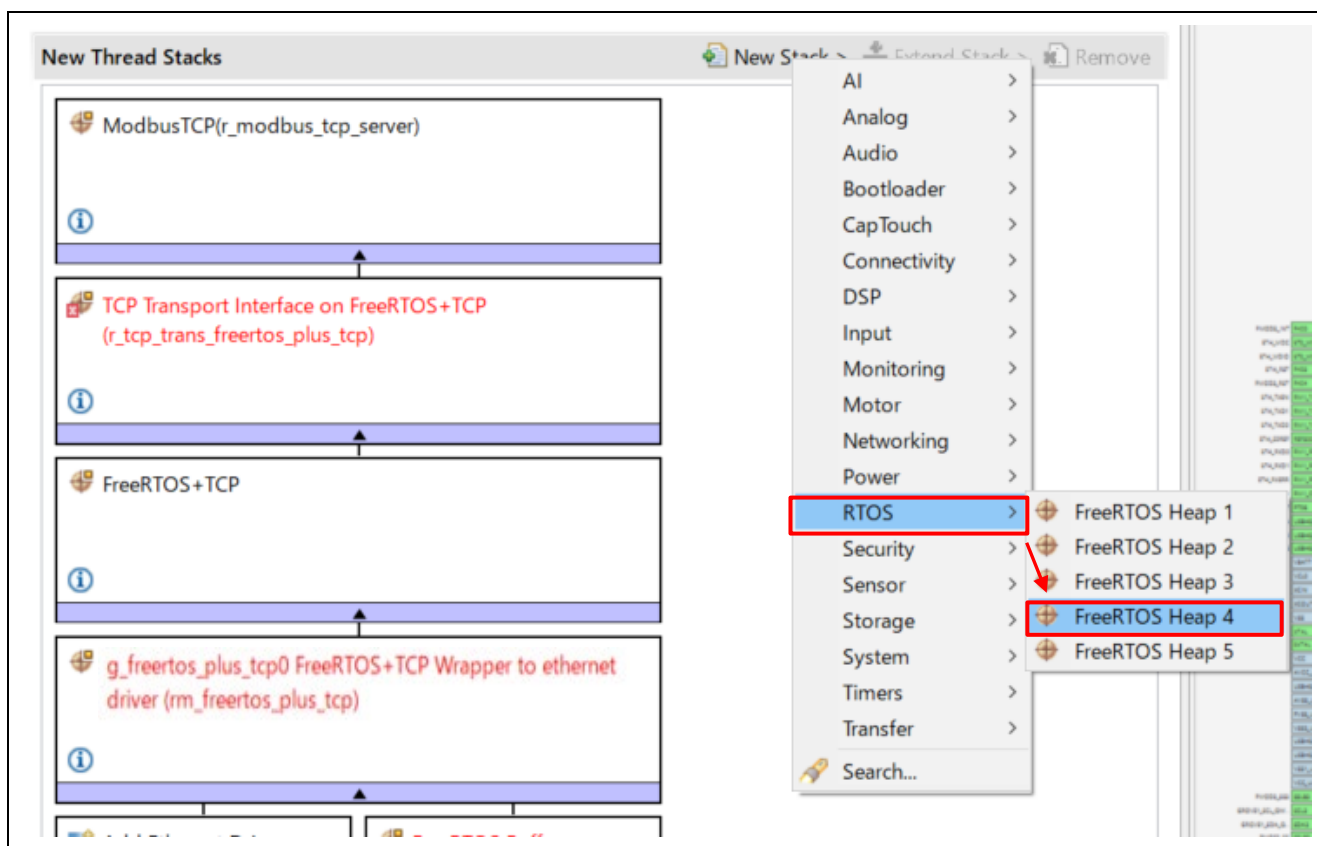


The stack is configured as follows:

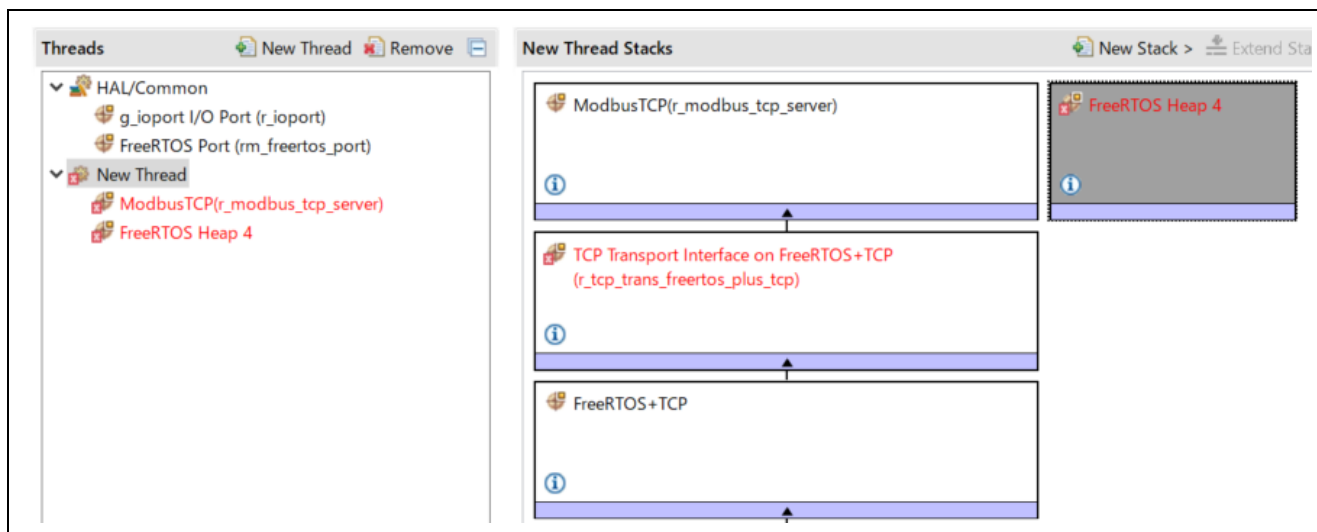


## 13. Add Heap

Select "New Stack" → "RTOS" → "FreeRTOS Heap 4".



The stack will be configured as follows:



## 14. Set Support Dynamic Allocation

Open “Properties” of “New Thread” in “Stacks” and change “Support Dynamic Allocation” inside “Memory Allocation” to “Enabled”.

The screenshot displays the Renesas RA IDE interface. In the 'Threads' panel, the 'New Thread' entry is selected and highlighted with a red box. A red arrow points from this box to the 'Properties' window. The 'Properties' window is open, showing the 'New Thread' settings. The 'Memory Allocation' section is expanded, and the 'Support Dynamic Allocation' property is highlighted with a red box and set to 'Enabled'. A red arrow also points from the 'Support Dynamic Allocation' box to the 'Enabled' value.

Property	Value
> Timers	
> Optional Functions	
> RA	
> Logging	
> Thread	
Symbol	new_thread0
Name	New Thread
Stack size (bytes)	1024
Priority	1
Thread Context	NULL
> Memory Allocation	
Clear Memory on Free	Disabled
Support Static Allocation	Enabled
Support Dynamic Allocation	Enabled
Total Heap Size	1024
Application Allocated Heap	Disabled

“FreeRTOS Heap4” stack configuration errors are resolved.

## 15. Set FreeRTOS+TCP

Open “Properties” of “FreeRTOS+TCP” in “Stacks” and change “Network Events call vApplicationIPNetworkEventHook”, “Use DHCP”, Total number of available network buffers and “FreeRTOS\_Select() (and associated) API function is available” in “Common” to the following values.

Network Events call vApplicationIPNetworkEventHook: **Disable**

Use DHCP : **Disable**

Total number of available network buffers : **30**

FreeRTOS\_Select() (and associated) API function is available: **Enable**

The screenshot shows the Renesas RA IDE interface. The 'New Thread Stacks' window is open, showing a list of stacks. The 'FreeRTOS+TCP' stack is selected and highlighted with a red box. A red arrow points from this stack to the 'Properties' window. The 'Properties' window is open, showing the 'FreeRTOS+TCP' settings. The 'Settings' tab is selected, and the 'Property' and 'Value' columns are visible. The following properties are highlighted with red boxes:

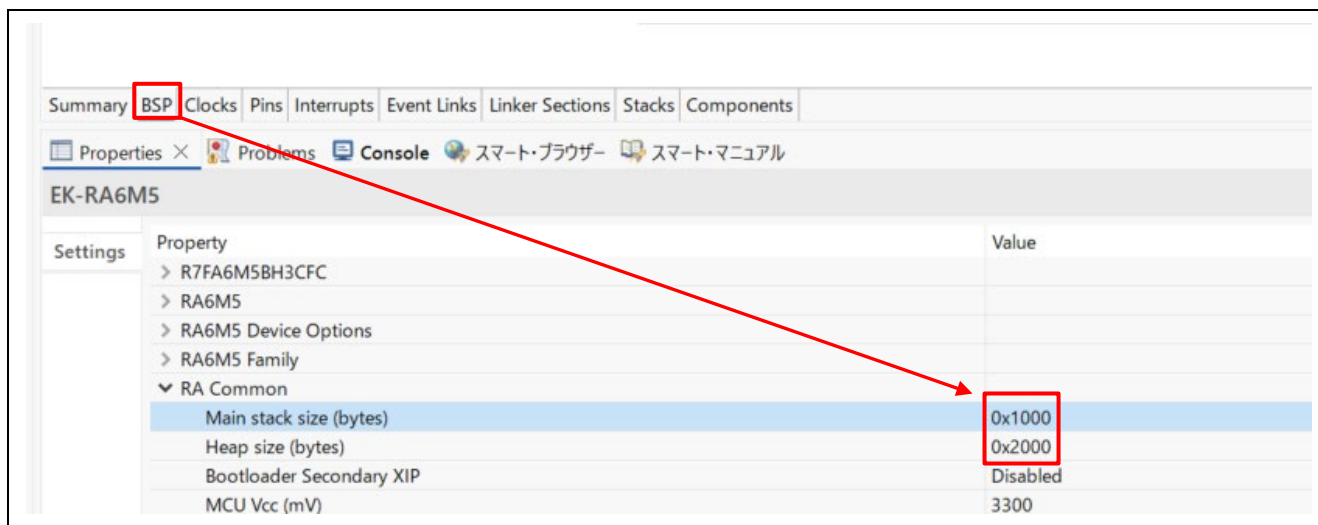
Property	Value
Stack size in words (not bytes)	configMINIMAL_STACK_SIZE * 5
Network Events call vApplicationIPNetworkEventHook	Disable
Max UDP send block time	15000 / portTICK_PERIOD_MS
Use DHCP	Disable
DHCP Register Hostname	Enable
DHCP Uses Unicast	Enable
DHCP callback function	Disable
Interval between transmissions	120000 / portTICK_PERIOD_MS
ARP Cache Entries	6
ARP Request Retransmissions	5
Maximum time before ARP table entry becomes stale	150
Use string for IP Address	Enable
Total number of available network buffers	30
Set the maximum number of events	ipconfigNUM_NETWORK_BUFFER_DESCRIPTORS + 5
Enable FreeRTOS_sendto() without calling Bind	Disable
TTL values for UDP packets	128
TTL values for TCP packets	128
Use TCP and all its features	Enable
Let TCP use windowing mechanism	Disable
Maximum number of bytes the payload of a network frame can contain	1500
Basic DNS client or resolver	Enable
Reply to incoming ICMP echo (ping) requests	Enable
FreeRTOS_SendPingRequest() is available	Disable
FreeRTOS_select() (and associated) API function is available	Enable
Filter out non Ethernet II frames.	Enable



## 16. Set Stack size

Open “Properties” of “BSP” and change “Main stack size” and “Heap size” in “RA Common” to the following values.

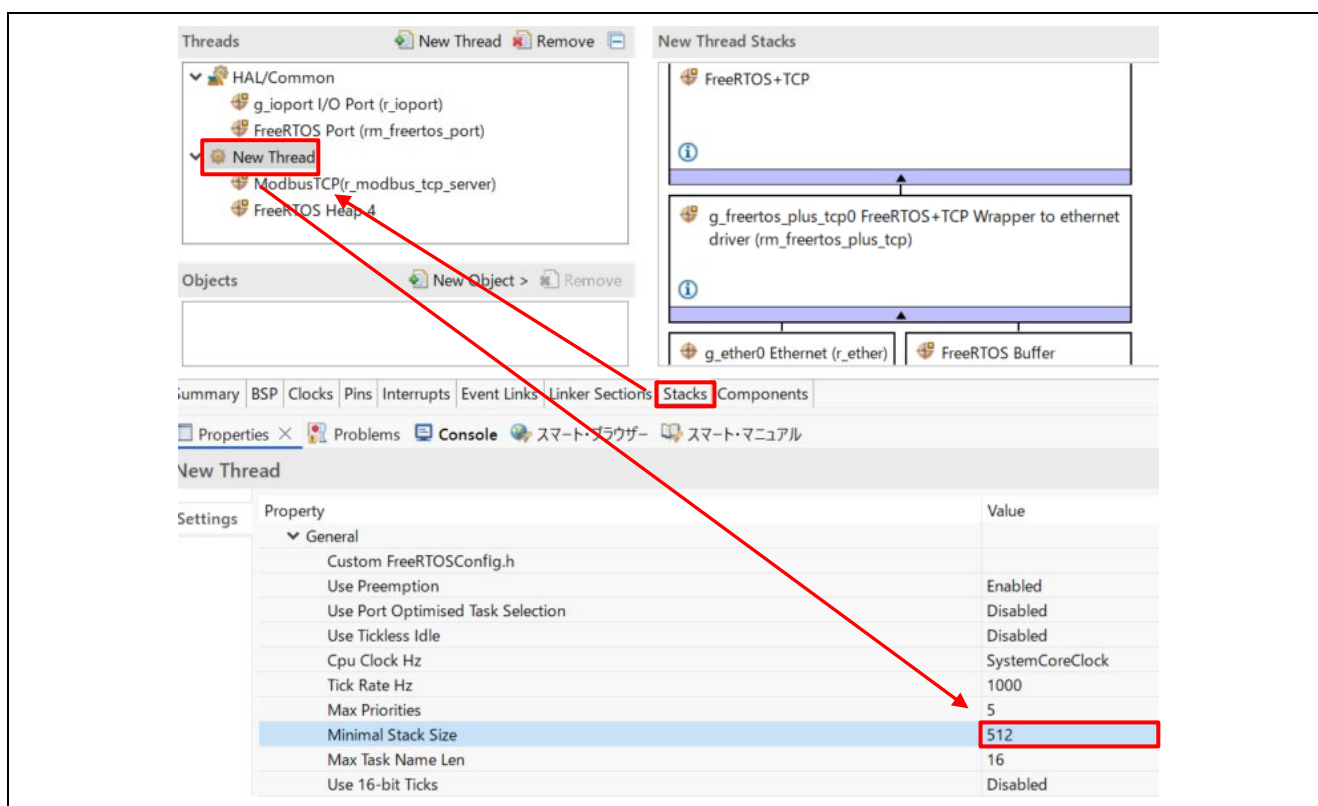
Main stack size : **0x1000**, Heap size : **0x2000**



The stack configuration error for "ModbusTCP (r\_modbus\_tcp\_server)" is now resolved.

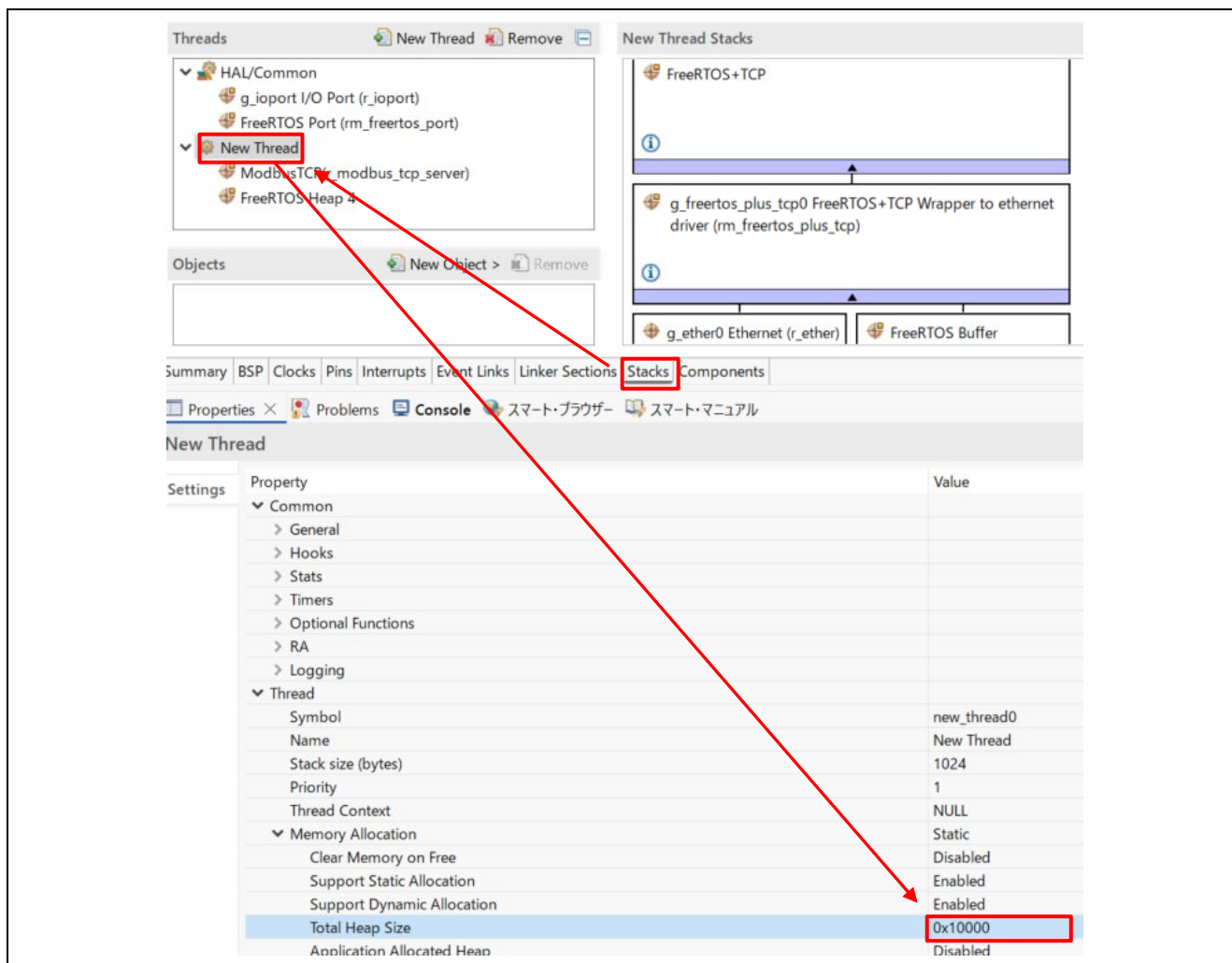
Open “Properties” of “New Thread”, then click on “Stacks” and change “Minimal Stack size” in “General” to the following values.

Minimal Stack size : **512**



Open “Properties” of “New Thread”, then click on “Stacks” and change “Total Heap Size” in “Memory Allocation” to the following values.

Total Heap Size : **0x10000**



17. Perform the steps for each evaluation board.

Refer to the following for the evaluation board you are using and follow the steps:

- EK-RA6M3, EK-RA6M4, EK-RA6M5, EK-RA8D1, EK-RA8M1, MCK-RA8T1 :  
[6.2.2 EK-RA6Mx / EK-RA8x1 / MCK-RA8T1 Creating Procedures](#)
- MCK-RA8T2 : [6.2.3. MCK-RA8T2 Creating Procedures](#)
- EK-RA8D2 : [6.2.4. EK-RA8D2 Creating Procedures](#)
- EK-RA8P1 : [6.2.5. EK-RA8P1 Creating Procedures](#)
- EK-RA8M2 : [6.2.6. EK-RA8M2 Creating Procedures](#)

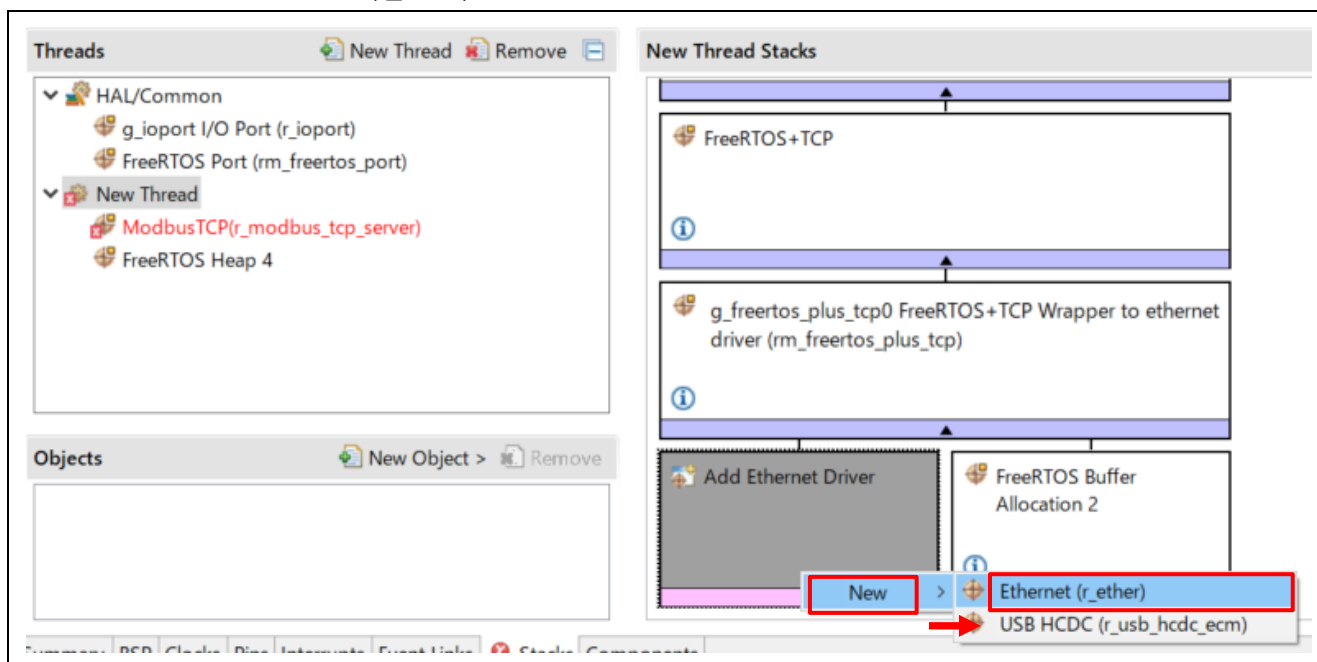


### 6.2.2 EK-RA6Mx / EK-RA8x1 / MCK-RA8T1 Creating Procedures

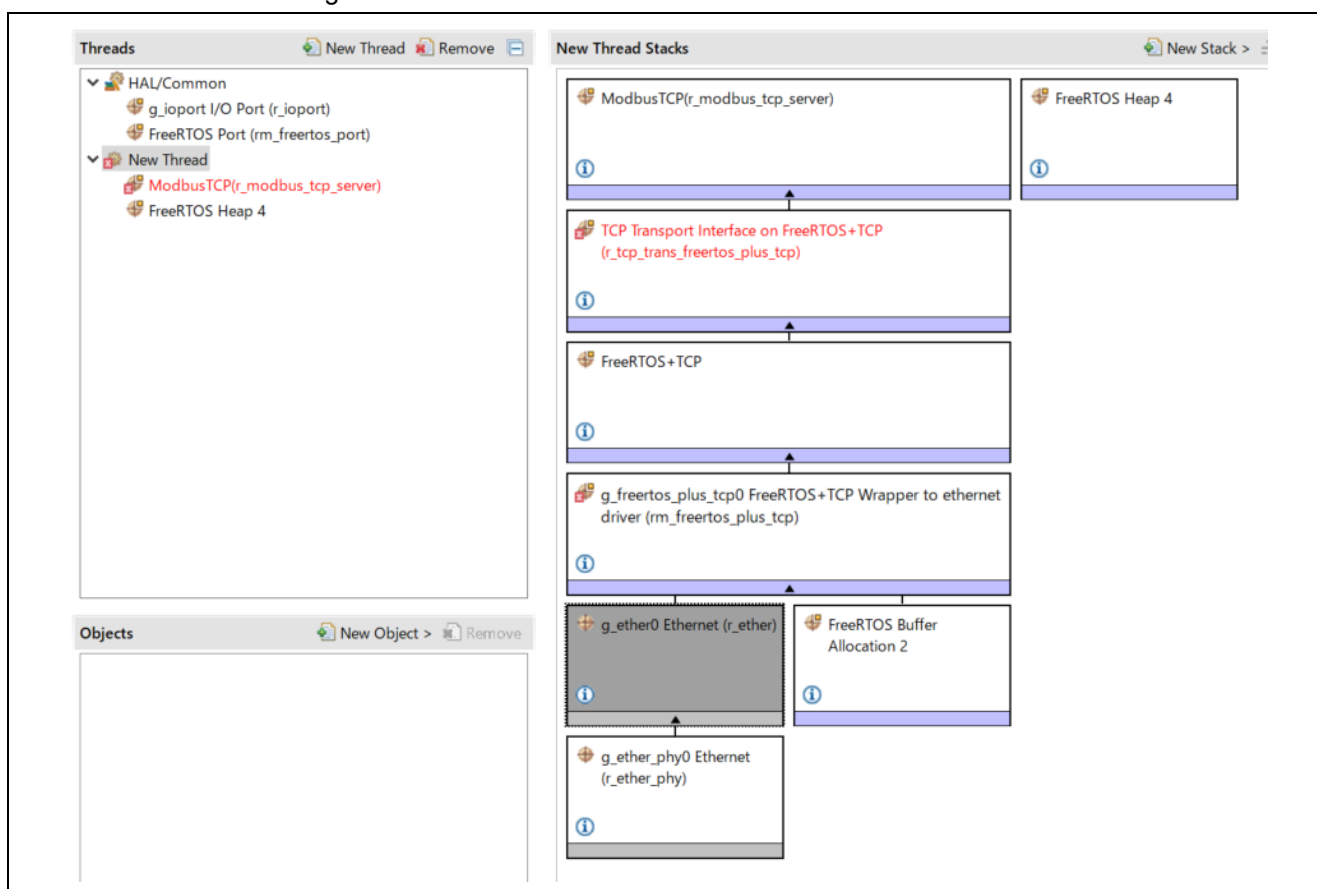
This section describes the procedures for creating EK-RA6Mx (EK-RA6M3, EK-RA6M4, EK-RA6M5) / EK-RA8x1 (EK-RA8D1, EK-RA8M1) / MCK-RA8T1.

#### 1. Add Ethernet Driver

Click “New” → “Ethernet (r\_ether)” to “Add Ethernet Driver”.



The stack will be configured as follows:



## 2. Set PHY Address

Open “Properties” of “g\_ether\_phy0 Ethernet (r\_ether\_phy)” in “Stacks” and change “PHY-LSI Address” in “Module g\_ether\_phy0 Ethernet (r\_ether\_phy)” to the port0 address configured on the evaluation board.

RA6xx : PHY Address : 0, RA8xx : PHY Address : 5

The screenshot displays the Renesas RA IDE interface. The 'Stacks' tab is selected, showing a hierarchy of components. The 'g\_ether\_phy0 Ethernet (r\_ether\_phy)' component is highlighted with a red box. A red arrow points from this component to the 'Properties' window, which shows the 'PHY-LSI Address' set to 0.

Property	Value
Common	
Module g_ether_phy0 Ethernet (r_ether_phy)	
Name	g_ether_phy0
Channel	0
PHY-LSI Address	0
PHY-LSI Reset Completion Timeout	0x00020000

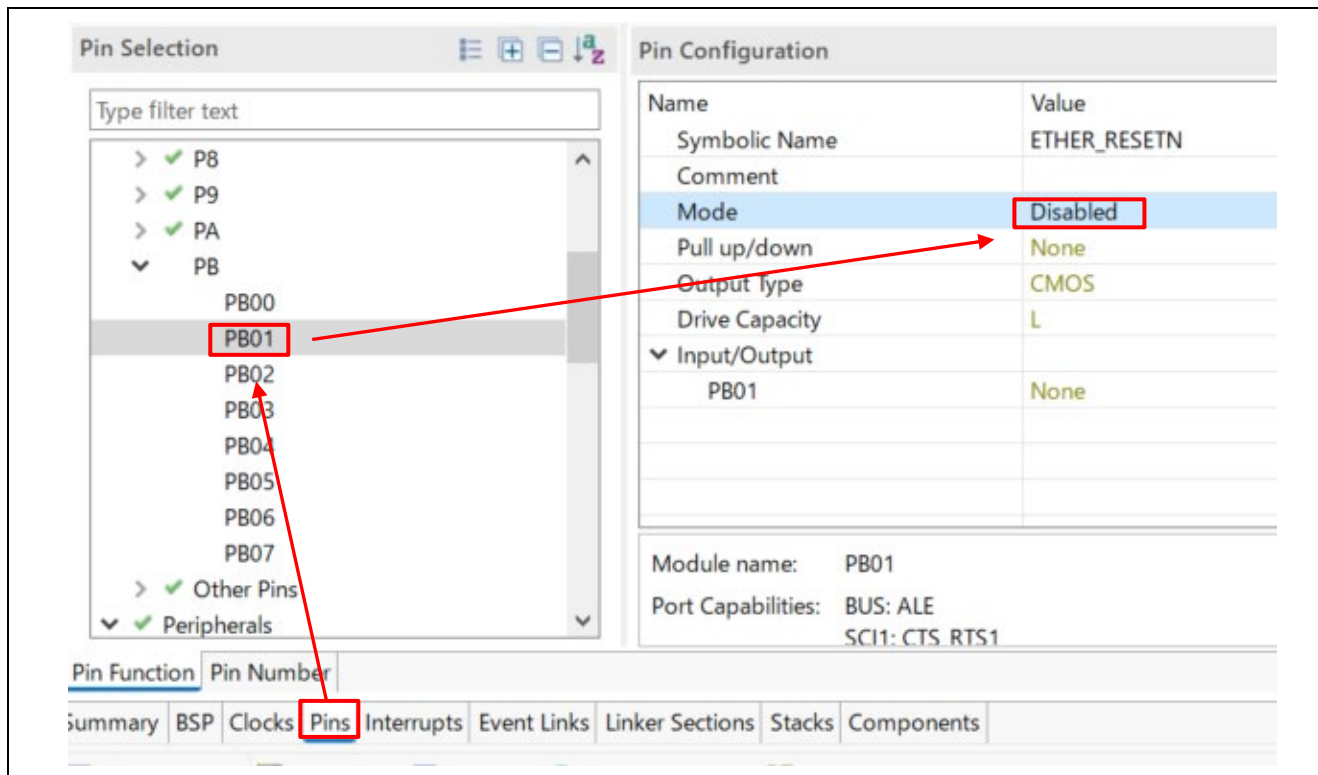
### 3. Set PHY Reset pin

The setting of the PHY Reset terminal on the evaluation boards RA8D1 and RA8T1 needs to be changed.

Open "Pin Configuration" of [Reset pin for evaluation board] (see below) in "Pins" and change "Mode" to "Disabled".

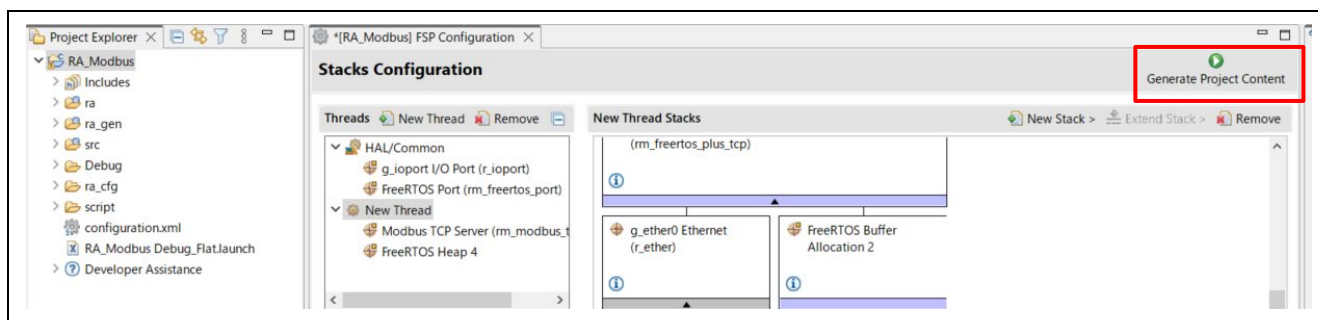
RA8D1 : **P706**, RA8T1 : **PB01**

**Note:** This procedure is not required for evaluation boards other than those listed above.



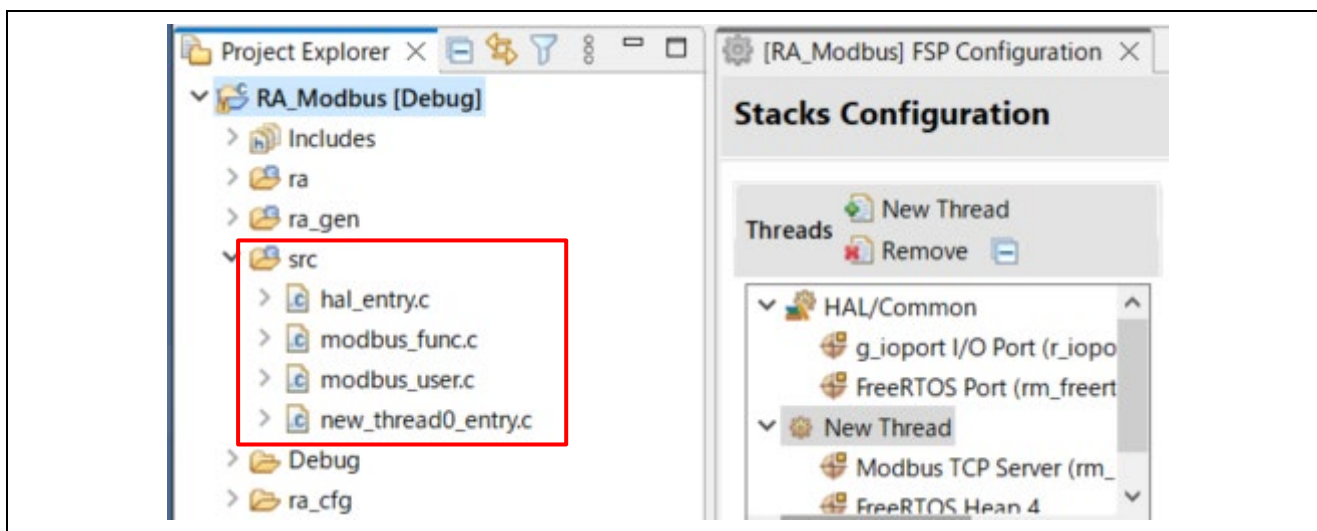
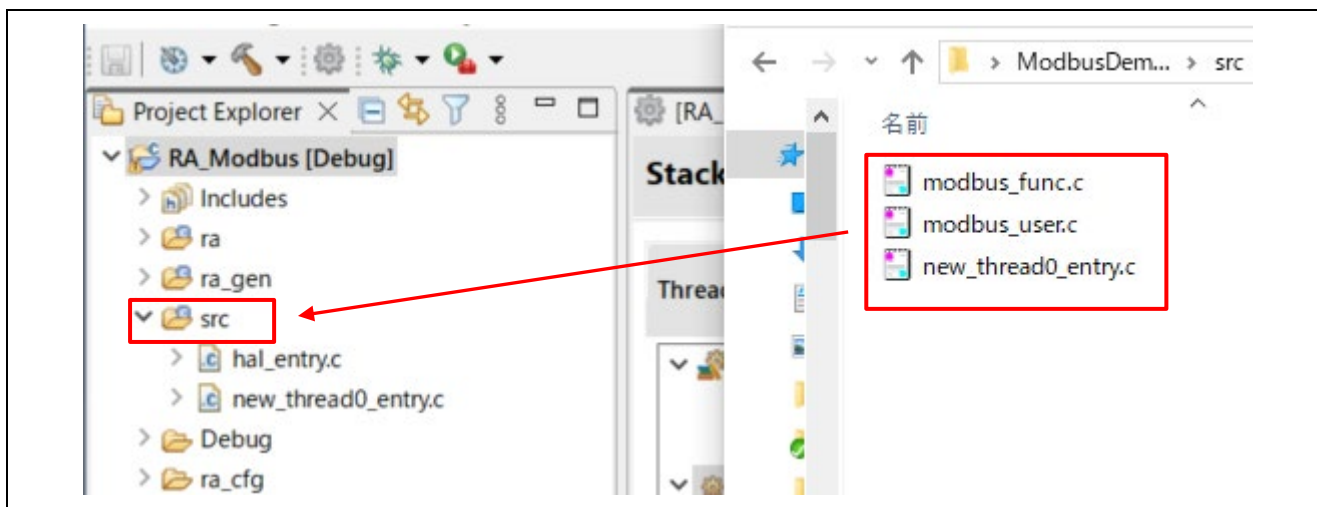
### 4. Generate the code

Generate the code with "Generate Project Content".



## 5. Add Modbus Sample Application

Copy modbus\_func.c, modbus\_user.c, and new\_thread0\_entry.c from the src folder of the sample program package to the src folder of the project and overwrite them.

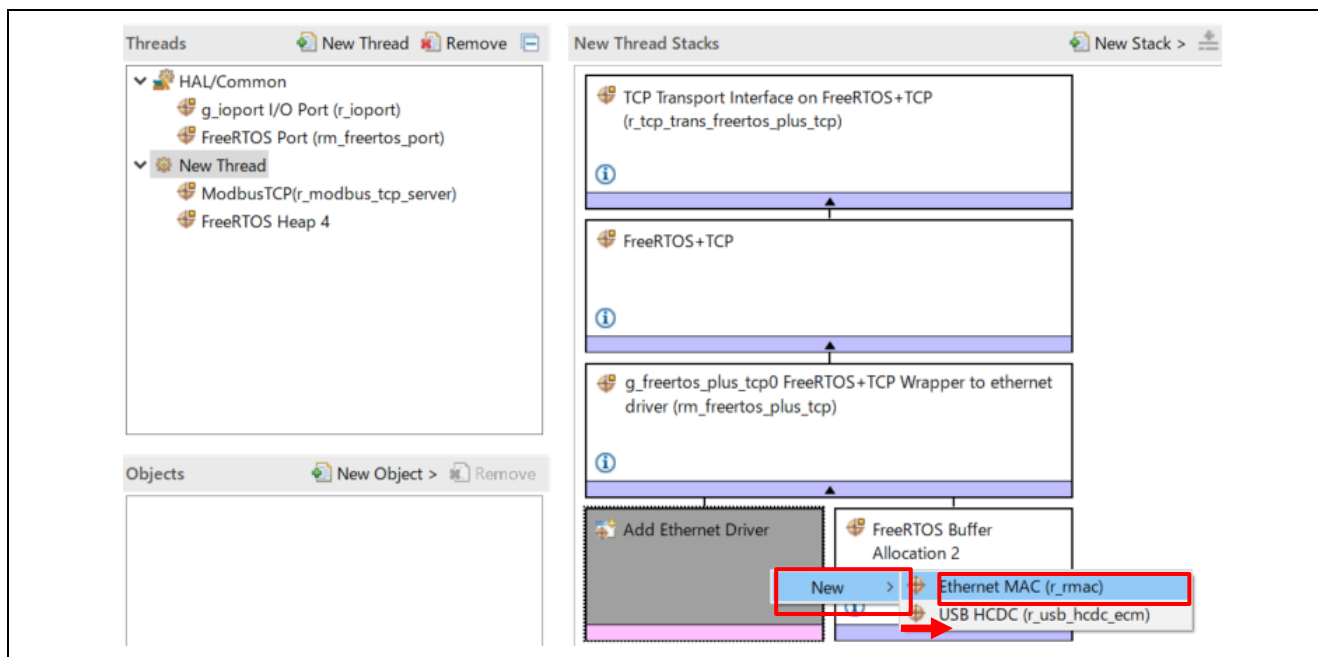


### 6.2.3 MCK-RA8T2 Creating Procedures

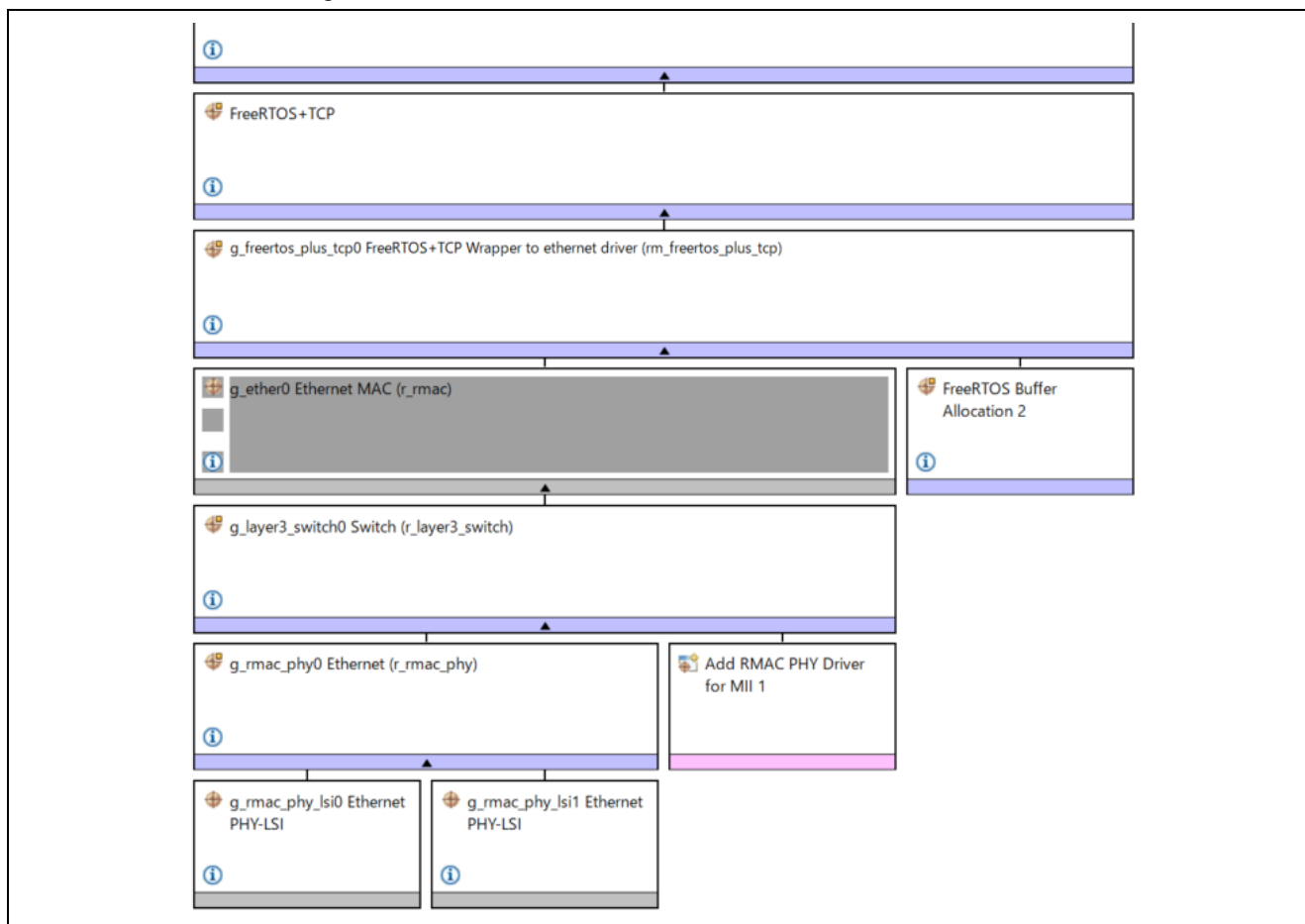
This section describes the procedures for creating MCK-RA8T2.

#### 1. Add Ethernet Driver

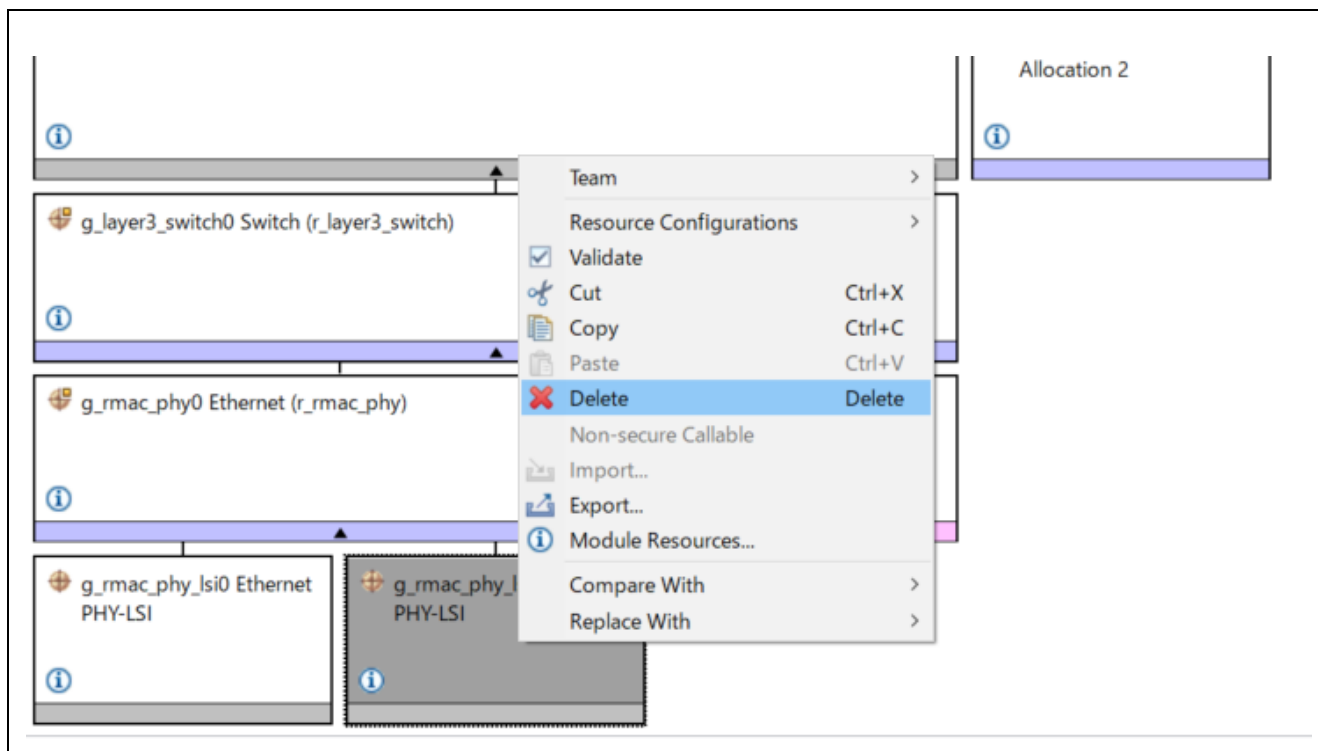
Click “New” → “Ethernet (r\_rmac)” to “Add Ethernet Driver”.



The stack will be configured as follows:

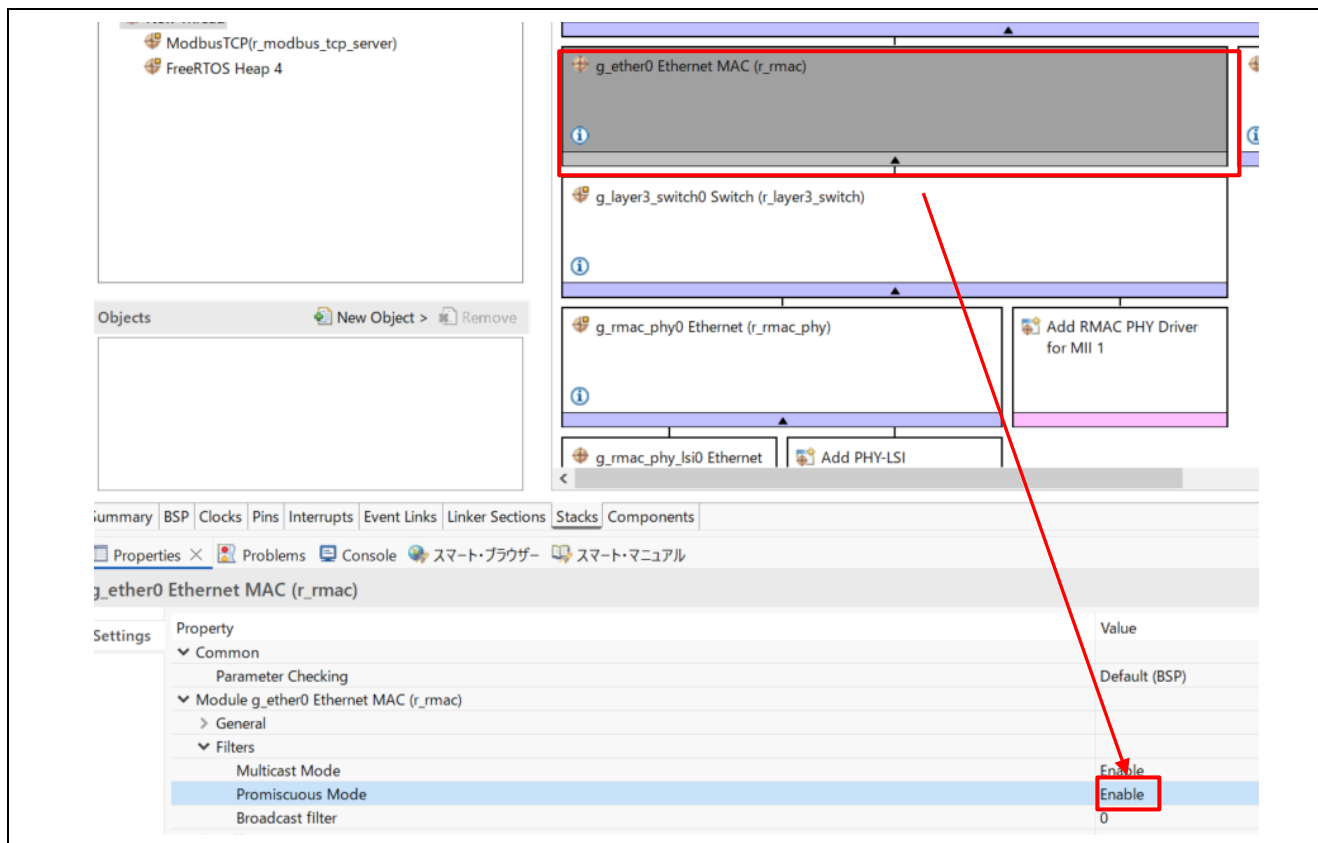


Right-click on “g\_rmac\_phy\_Isi1 Ethernet PHY-LSI”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.



## 2. Set r\_rmac

Change the “Stacks” → “g\_ether0 Ethernet MAC (r\_rmac)” → “Module g\_ether0 Ethernet MAC (r\_rmac)” → “Promiscuous Mode” in “Filters” to “Enable”.



- Set `r_layer3_switch`  
Open "Properties" of "g\_layer3\_switch0 Switch (r\_layer3\_switch)" in "Stacks" and change "gPTP enable" to the following values.

gPTP enable : **Disabled**

The screenshot shows the configuration tool interface. On the left, a tree view lists components: HAL/Common, g\_ioport I/O Port (r\_ioport), FreeRTOS Port (rm\_freertos\_port), New Thread, ModbusTCP(r\_modbus\_tcp\_server), and FreeRTOS Heap 4. The main area displays a stack diagram with components: g\_layer3\_switch0 Switch (r\_layer3\_switch), g\_rmac\_phy0 Ethernet (r\_rmac\_phy), g\_rmac\_phy\_lsi0 Ethernet PHY-LSI, and Add PHY-LSI configuration for MII 1. The 'Stacks' tab is selected, and the 'Properties' window for 'g\_layer3\_switch0 Switch (r\_layer3\_switch)' is open. The 'gPTP enable' property is set to 'Disabled'.

Property	Value
Common	
Parameter Checking	Default (BSP)
Available queue num	4
gPTP enable	Disabled
Time Aware Shaper	Disabled
Module g_layer3_switch0 Switch (r_layer3_switch)	

## 4. Set r\_rmac\_phy

Open “Properties” of “g\_mac\_phy0 Ethernet (r\_rmac\_phy)” in “Stacks” and change “Select MII type”, “MDIO hold timing adjustment”, and “MDIO capture timing adjustment” in “Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)” to the following values.

Select MII type : **MI**

MDIO holds timing adjustment: **7**

MDIO capture timing adjustment : **7**

Property	Value
Name	g_mac_phy0
Channel	0
Default PHY-LSI port	0
PHY-LSI Reset Completion Timeout	0x00020000
Select MII type	<b>MI</b>
Port Custom Init Function	NULL
Port Custom Link Partner Ability Get Function	NULL
Flow Control	Disable
Management frame format	Clause 22 frame format
MDC clock rate (Hz)	2500000
MDIO hold timing adjustment	<b>7</b>
MDIO capture timing adjustment	<b>7</b>

## 5. Set PHY Address

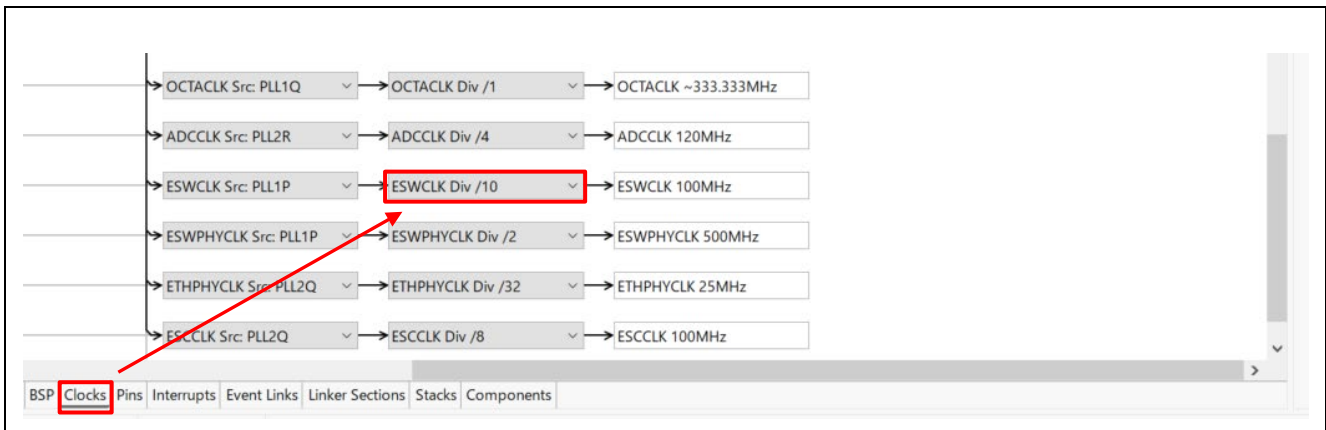
Open “Properties” of “g\_mac\_phy\_1si0 Ethernet PHY LSI” in “Stacks” and change “PHY-LSI Address” in “Module g\_mac\_phy\_1si0 Ethernet PHY LSI” to “1”.

Property	Value
Name	g_mac_phy_1si0
PHY-LSI Address	<b>1</b>
PHY-LSI type	Kit Component



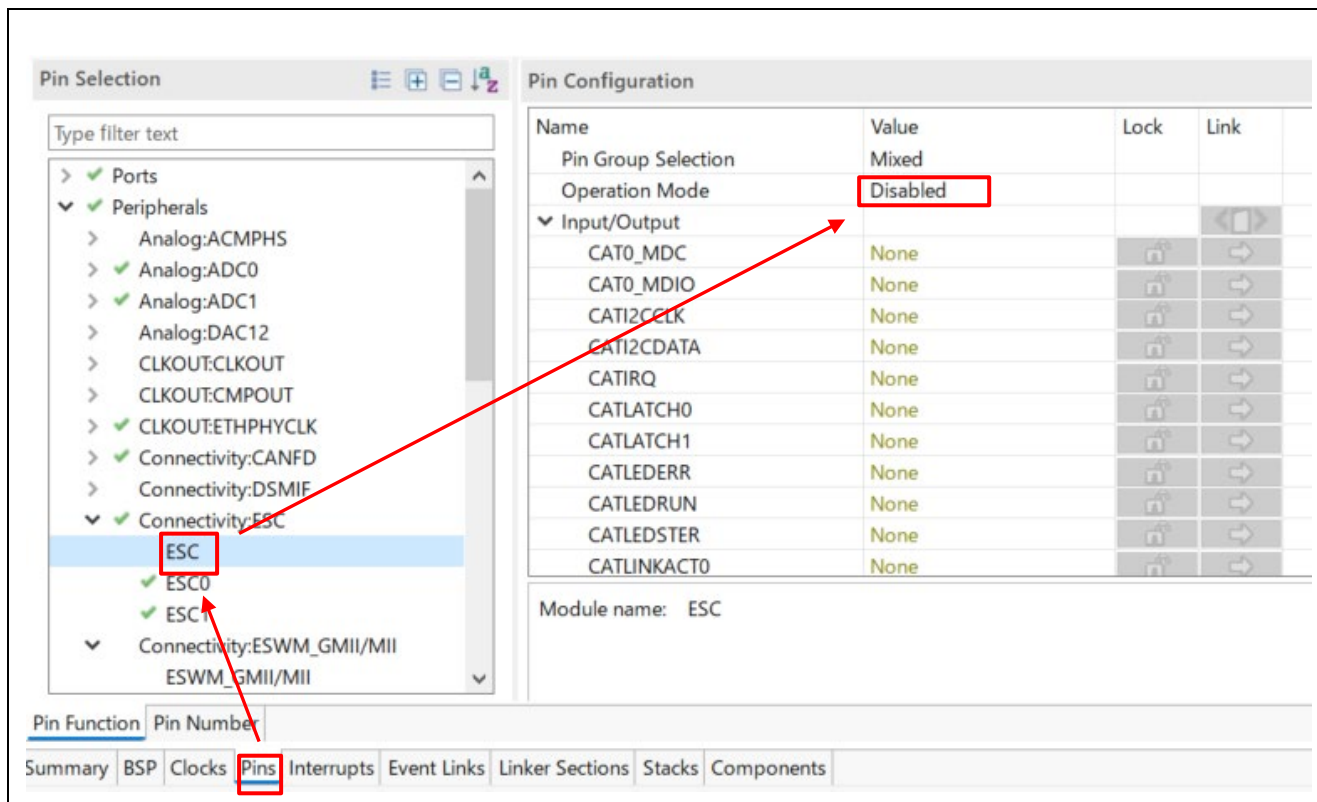
**6. Set ESW Clock**

Change the “ESWCLK Div” at the bottom of “Clocks” to “ESWCLK Div /10”.



## 7. Set ESWM Terminals

Change the "Operation Mode" of "Pins" → "Peripherals" → "Connectivity: ESC" → "ESC" to "Disabled".  
Change the "Operation Mode" of "ESC0" and "ESC1" to "Disabled" as well.



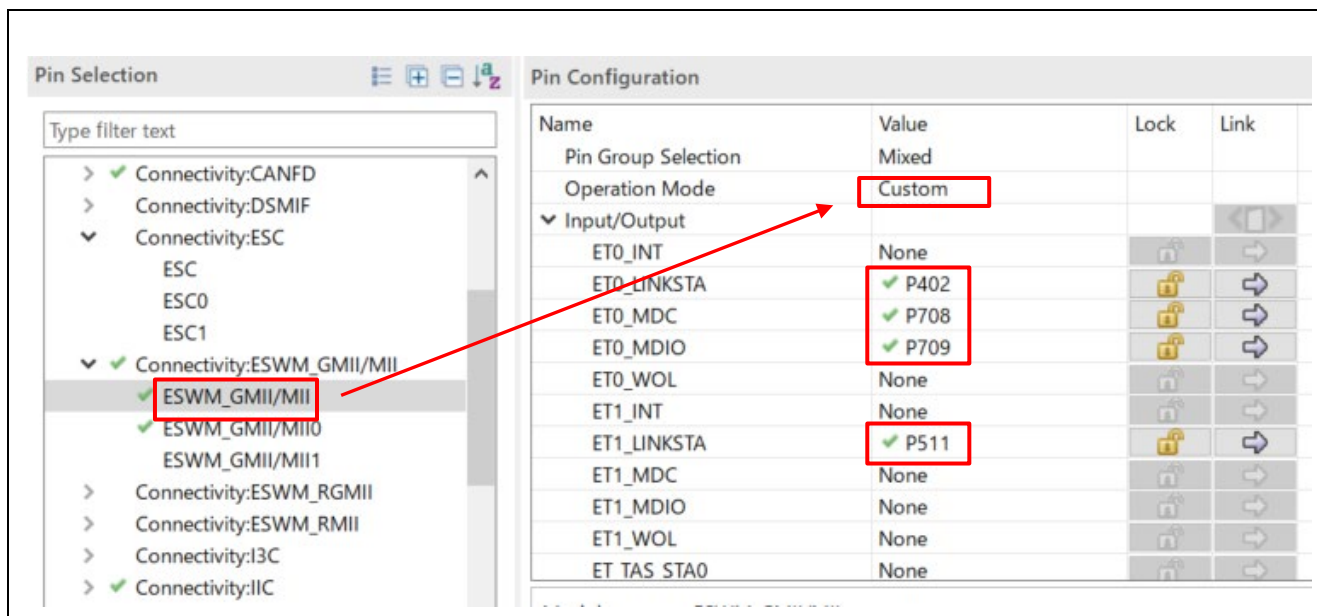
After changing the "Operation Mode" of "Pins" → "Peripherals" → "Connectivity: ESWM\_GMII/MII" → "ESWM\_GMII/MII" to "Custom", change the pins as follows:

ET0\_LINKSTA : P402

ET0\_MDC : P708

ET0\_MDIO : P709

ET1\_LINKSTA : P511



After changing the "Operation Mode" of "Pins" → "Peripherals" → "Connectivity: ESWM\_GMII/MII" → "ESWM\_GMII/MII0" to "Custom", change the pins as follows:

ET0\_RXD0 : **P702**  
 ET0\_RXD1 : **P701**  
 ET0\_RXD2 : **P700**  
 ET0\_RXD3 : **P406**  
 ET0\_RX\_CLK : **P703**  
 ET0\_RX\_DV : **P405**  
 ET0\_RX\_ER : **P704**  
 ET0\_TXD0 : **PB00**  
 ET0\_TXD1 : **PB02**  
 ET0\_TXD2 : **PB03**  
 ET0\_TXD3 : **PB04**  
 ET0\_TX\_CLK : **PB01**  
 ET0\_TX\_EN : **P705**

Name	Value	Lock	Link
Pin Group Selection	Mixed		
Operation Mode	Custom		
Input/Output			
ET0_GTX_CLK	None		
ET0_RXD0	✓ P702		
ET0_RXD1	✓ P701		
ET0_RXD2	✓ P700		
ET0_RXD3	✓ P406		
ET0_RXD4	None		
ET0_RXD5	None		
ET0_RXD6	None		
ET0_RXD7	None		
ET0_RX_CLK	✓ P703		
ET0_RX_DV	✓ P405		
ET0_RX_ER	✓ P704		
ET0_TXD0	✓ PB00		
ET0_TXD1	✓ PB02		
ET0_TXD2	✓ PB03		
ET0_TXD3	✓ PB04		
ET0_TXD4	None		
ET0_TXD5	None		
ET0_TXD6	None		
ET0_TXD7	None		
ET0_TX_CLK	✓ PB01		
ET0_TX_EN	✓ P705		
ET0_TX_ER	None		

## 8. Set PHY Reset Terminals

Change the "Mode" of "Pins" → "Ports" → "P7" → "P711" to "Output mode (Initial High)".

The screenshot shows the Pin Configuration tool interface. On the left, the 'Pin Selection' pane lists pins P5, P6, and P7. Under P7, pins P700 through P713 are listed, with P711 highlighted. A red box is around P711, and a red arrow points from it to the 'Mode' field in the 'Pin Configuration' table. The 'Mode' field is set to 'Output mode (Initial High)' and is also highlighted with a red box. Below the table, the 'Module name' is P711 and 'Port Capabilities' include AGT0: AGTEE0 and ESC: CATRESETOUT. At the bottom, the 'Pins' tab is selected in the navigation bar.

Name	Value	Link
Symbolic Name		
Comment		
Mode	Output mode (Initial High)	
Pull up/down	None	
IRQ	None	
Output Type	CMOS	
Drive Capacity	L	
Input Latch	None	
Input/Output	P711	GPIO

Module name: P711  
Port Capabilities: AGT0: AGTEE0  
ESC: CATRESETOUT

Pin Function | Pin Number

Summary | BSP | Clocks | Pins | Interrupts | Event Links | Linker Sections | Stacks | Components

## 9. Set PHY CLK

Change the "Drive Capacity" of "Pins" → "Ports" → "P7" → "P706" to "H".

The screenshot shows the Pin Configuration tool interface. On the left, the 'Pin Selection' pane lists pins P5, P6, and P7. Under P7, pins P700 through P713 are listed, with P706 highlighted. A red box is around P706, and a red arrow points from it to the 'Drive Capacity' field in the 'Pin Configuration' table. The 'Drive Capacity' field is set to 'H' and is also highlighted with a red box. Below the table, the 'Module name' is P706 and 'Port Capabilities' include AGT0: AGTIO0 and DSMIF1: DSM1CLK0. At the bottom, the 'Pins' tab is selected in the navigation bar.

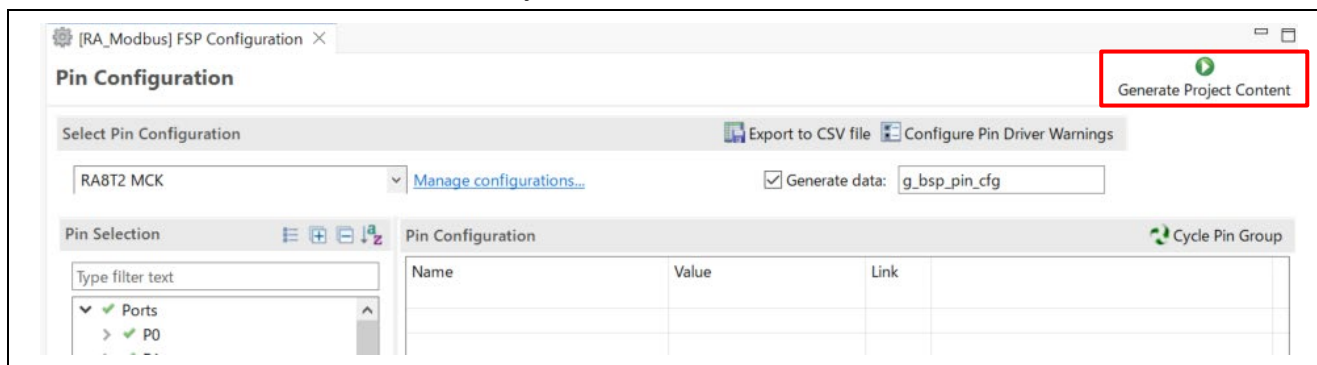
Name	Value	Link
Symbolic Name		
Comment		
Mode	Peripheral mode	
Pull up/down	None	
IRQ	None	
Output Type	CMOS	
Drive Capacity	H	
Input Latch	None	
Input/Output	P706	ETHPHYCLK_ETHPHYCLK

Module name: P706  
Port Capabilities: AGT0: AGTIO0  
DSMIF1: DSM1CLK0

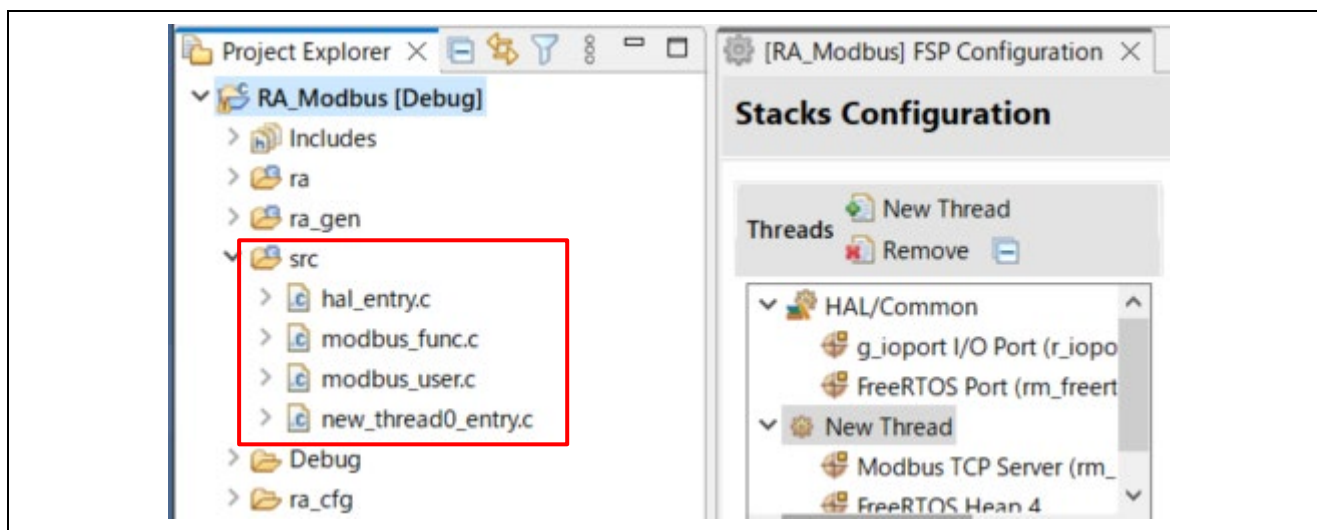
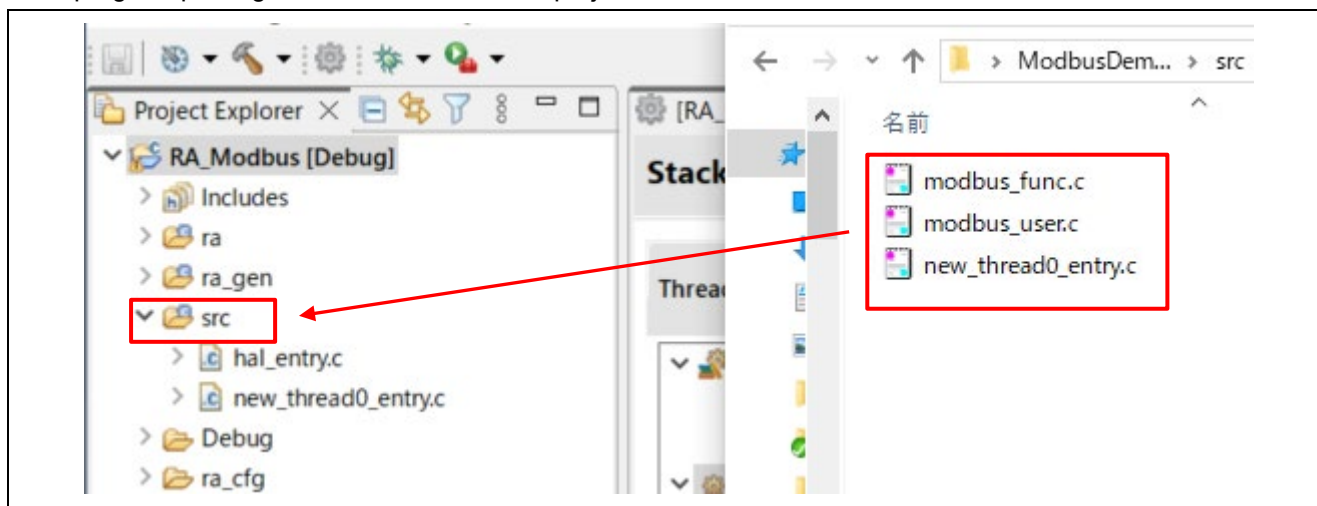
Pin Function | Pin Number

Summary | BSP | Clocks | Pins | Interrupts | Event Links | Linker Sections | Stacks | Components

10. Generate the code  
Generate the code with "Generate Project Content".



11. Add Modbus Sample Application  
Copy modbus\_func.c, modbus\_user.c, and new\_thread0\_entry.c from the src folder of the sample program package to the src folder of the project and overwrite them.



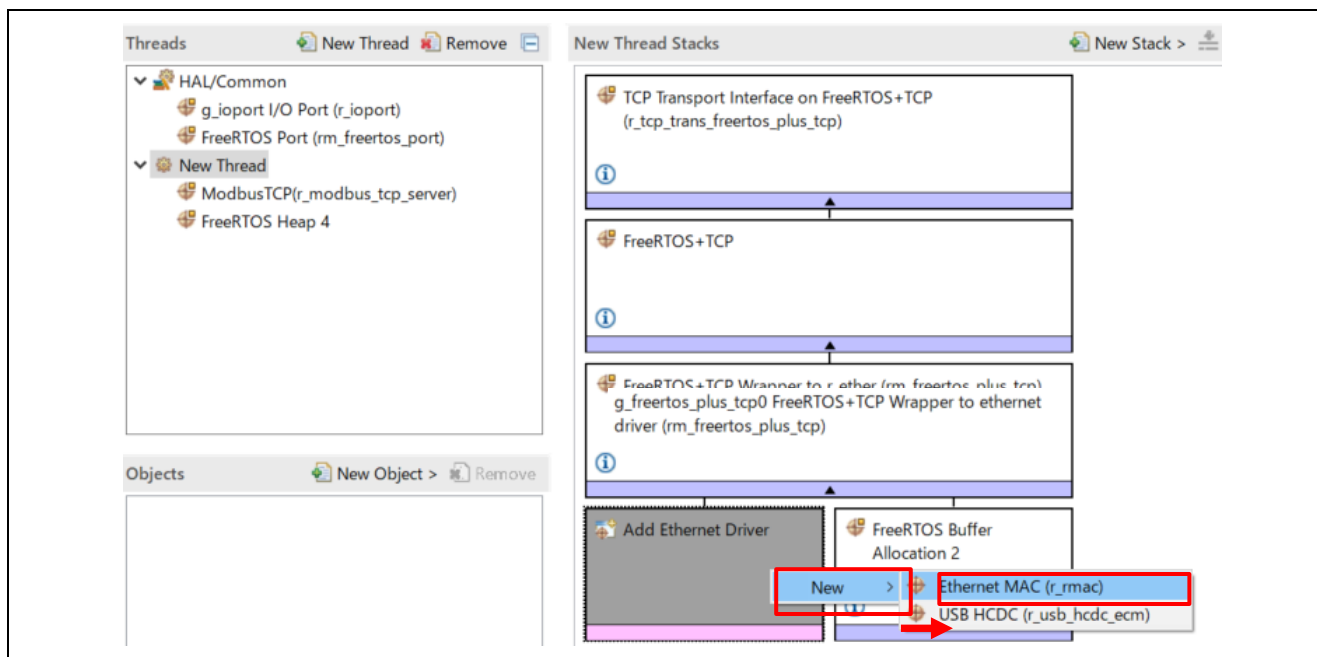


## 6.2.4 EK-RA8D2 Creating Procedures

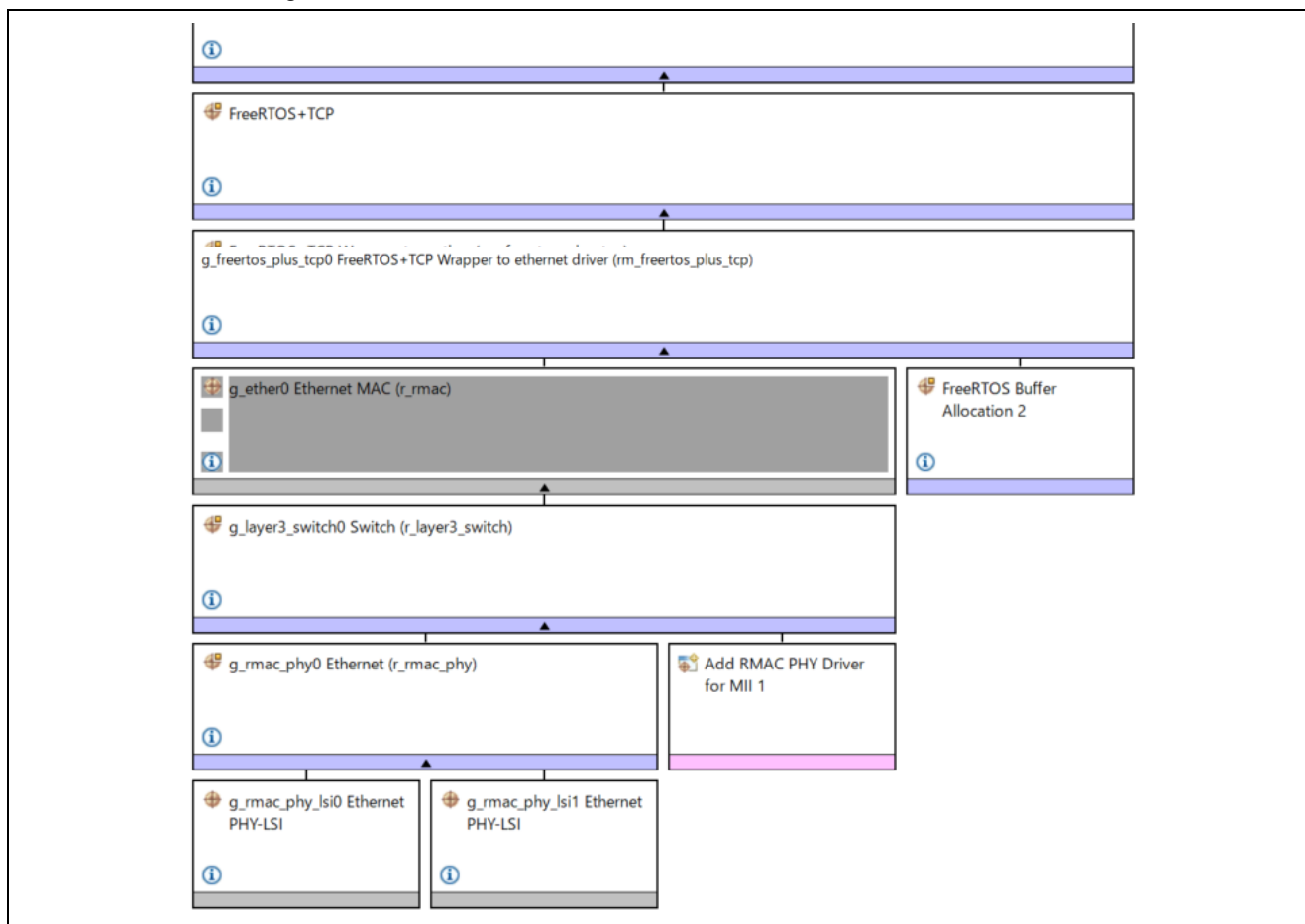
This section describes the procedures for creating EK-RA8D2.

### 1. Add Ethernet Driver

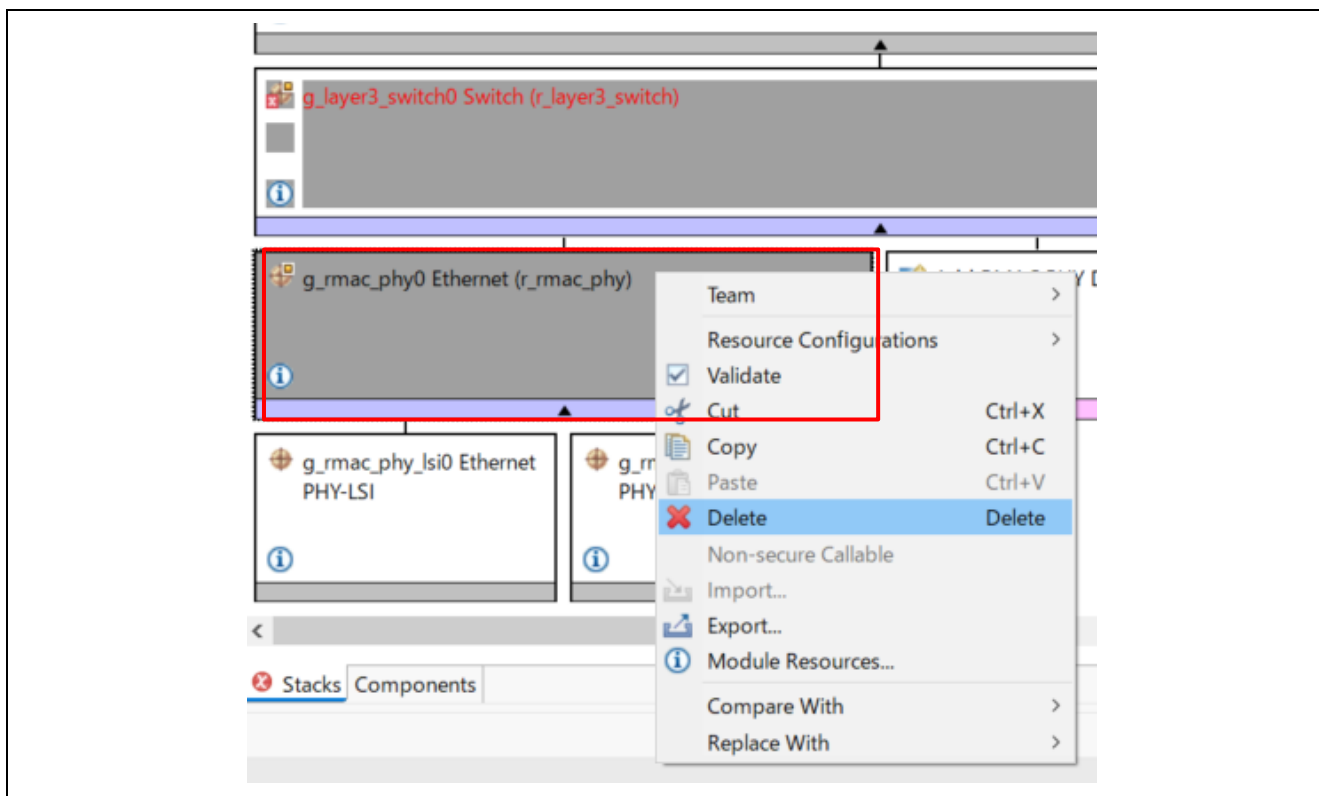
Click “New” → “Ethernet (r\_rmac)” to “Add Ethernet Driver”.



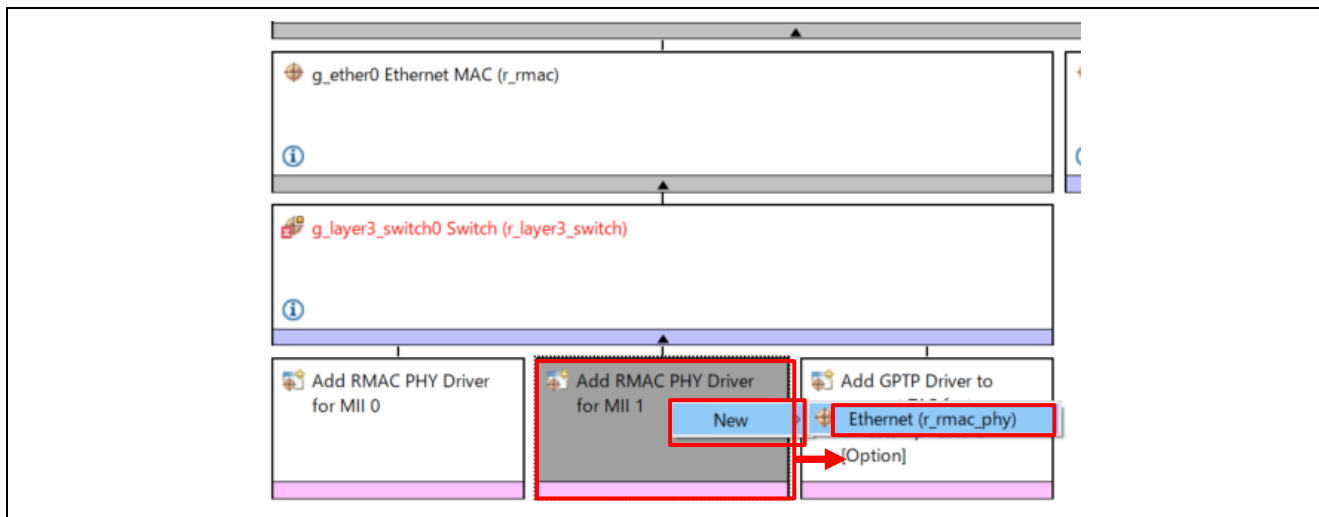
The stack will be configured as follows:



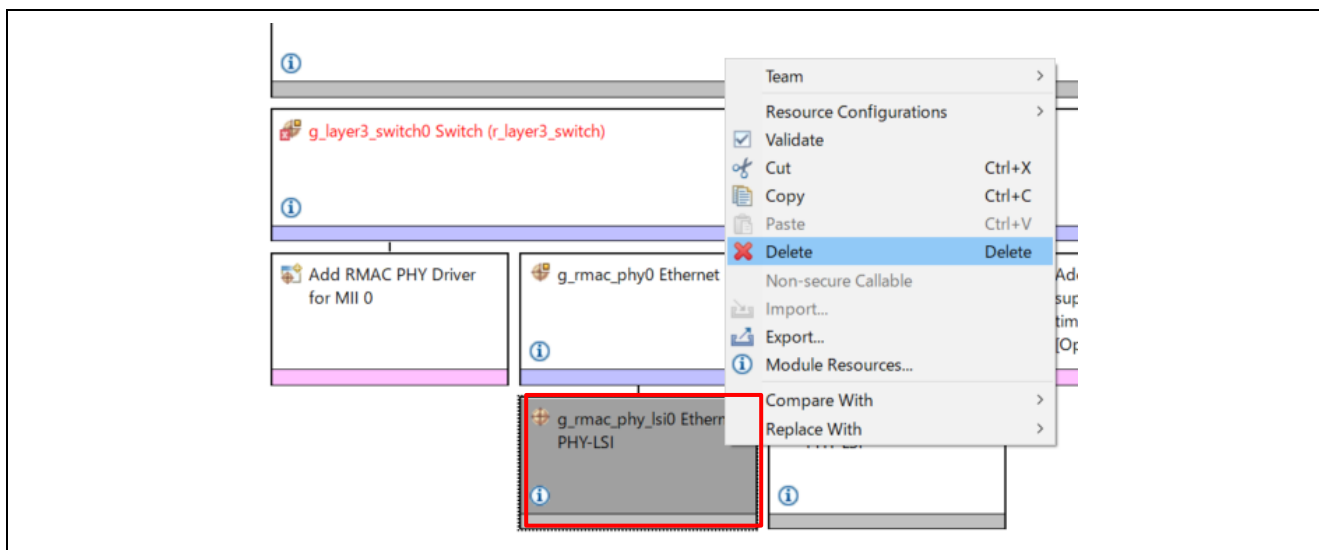
Right-click on “g\_mac\_phy0 Ethernet (r\_rmac\_phy)”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.



Click “New” → “Ethernet (r\_rmac\_phy)” to “Add RMAC PHY Driver for MII1”.



Right-click on “g\_rmac\_phy\_Isi0 Ethernet PHY-LSI”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.





2. Set r\_rmac
- Open “Properties” of “g\_ether0 Ethernet MAC (r\_rmac)” in “Stacks” and change “Channel” and “Promiscuous Mode” in “Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)” to the following values.

Channel : 1

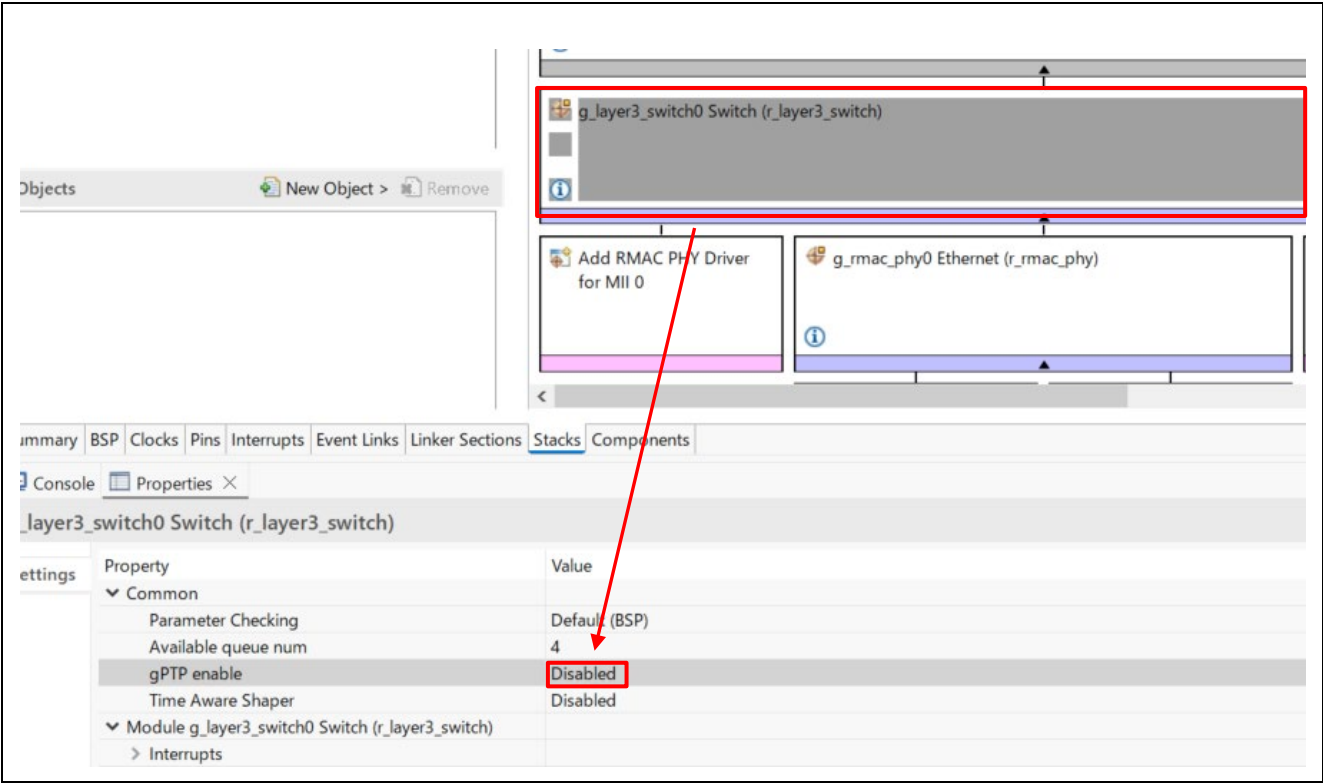
Promiscuous Mode : **Enable**

The screenshot shows the Renesas RA IDE interface. On the left, the 'Objects' pane lists several components: FreeRTOS Port (rm\_freertos\_port), New Thread, ModbusTCP(r\_modbus\_tcp\_server), and FreeRTOS Heap 4. The main workspace displays a stack of components: g\_ether0 Ethernet MAC (r\_rmac) at the top, followed by g\_layer3\_switch0 Switch (r\_layer3\_switch). The 'g\_ether0 Ethernet MAC (r\_rmac)' component is highlighted with a red box. Below the workspace, the 'Properties' window is open for the selected component. The 'Properties' window has tabs for 'Primary', 'BSP', 'Clocks', 'Pins', 'Interrupts', 'Event Links', 'Linker Sections', 'Stacks', and 'Components'. The 'Stacks' tab is active. The 'Properties' window shows the configuration for the 'Module g\_mac\_phy0 Ethernet (r\_rmac)' component. The 'Channel' property is set to 1, and the 'Promiscuous Mode' property is set to Enable. A red arrow points from the 'g\_ether0 Ethernet MAC (r\_rmac)' component in the workspace to the 'Channel' property in the 'Properties' window.

Property	Value
▼ Common	
Parameter Checking	Default (BSP)
▼ Module g_mac_phy0 Ethernet (r_rmac)	
▼ General	
Name	g_ether0
Channel	1
Zero-copy Mode	Disable
Flow control functionality	Disable
MAC address	00:11:22:33:44:55
▼ Filters	
Multicast Mode	Enable
Promiscuous Mode	Enable
Broadcast filter	0

3. Set r\_layer3\_switch  
Open “Properties” of “g\_layer3\_switch0 Switch (r\_layer3\_switch)” in “Stacks” and change “gPTP enable” to the following values.

gPTP enable : **Disabled**



## 4. Set r\_rmac\_phy

Open "Properties" of "g\_mac\_phy0 Ethernet (r\_rmac\_phy)" in "Stacks" and change "Channel", "Default PHY-LSI port" and "Select MII type" in "Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)" to the following values.

Channel : 1

Default PHY-LSI port : 1

Select MII type : **RGMII**

The screenshot shows the IDE interface with the 'Stacks' tab selected. The 'g\_mac\_phy0 Ethernet (r\_rmac\_phy)' component is highlighted in the 'Stacks' view. The 'Properties' window for this component is open, showing the 'Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)' section. The 'Select MII type' property is set to 'RGMII' and is highlighted with a red box. A red arrow points from the component in the 'Stacks' view to the 'Select MII type' property in the 'Properties' window.

Property	Value
Parameter Checking	Default (BSP)
KSZ8091RNB Target	Disabled
KSZ8041 Target	Disabled
DP83620 Target	Disabled
ICS1894 Target	Disabled
GPY111 Target	Disabled
User Own Target	Disabled
Reference Clock	Default
Module g_mac_phy0 Ethernet (r_rmac_phy)	
Name	g_mac_phy0
Channel	1
Default PHY-LSI port	1
PHY-LSI Reset Completion Timeout	0x00020000
Select MII type	RGMII
Port Custom Init Function	NULL
Port Custom Link Partner Ability Get Function	NULL
Flow Control	Disable
Management frame format	Clause 22 frame format
MDC clock rate (Hz)	25000000
MDIO hold timing adjustment	0
MDIO capture timing adjustment	0

## 5. Set ESW Clock

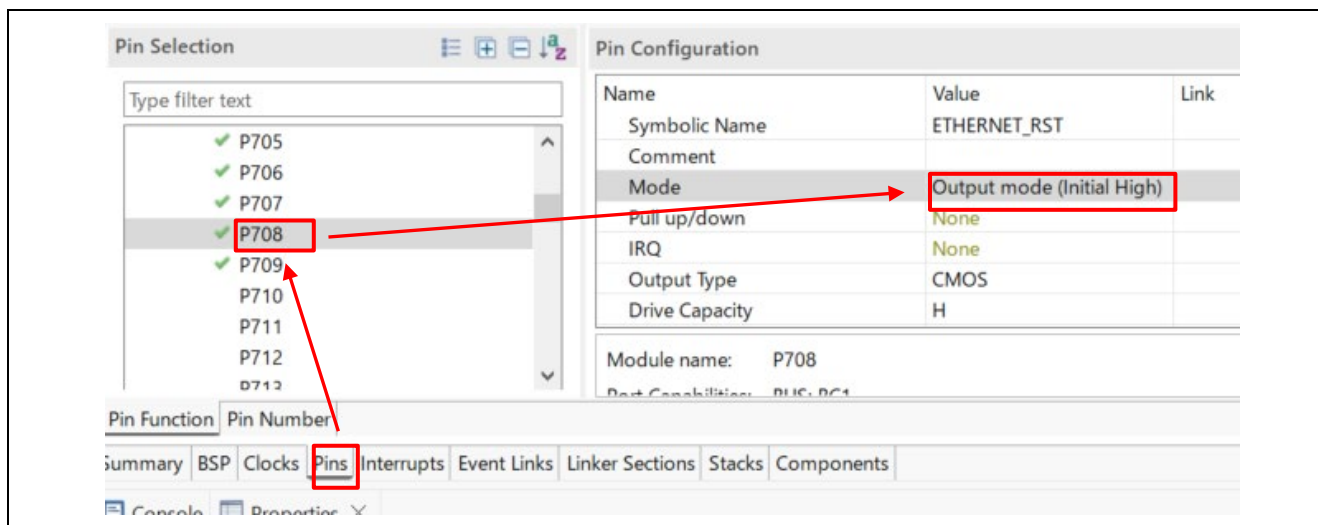
Change the "ESWCLK Div" at the bottom of "Clocks" to "ESWCLK Div /10".

The screenshot shows the IDE interface with the 'Clocks' tab selected. The 'Clocks' configuration is displayed, showing the 'ESWCLK Div' dropdown menu set to '/10'. A red arrow points from the 'ESWCLK Div' dropdown menu to the 'ESWCLK Div /10' option.

Source	Div	Frequency
ADCCLK Src: PLL2R	ADCCLK Div /4	ADCCLK 120MHz
ESWCLK Src: PLL1P	ESWCLK Div /10	ESWCLK 100MHz
ESWPHYCLK Src: PLL1P	ESWPHYCLK Div /2	ESWPHYCLK 500MHz
ETHPHYCLK Src: PLL2Q	ETHPHYCLK Div /32	ETHPHYCLK 25MHz

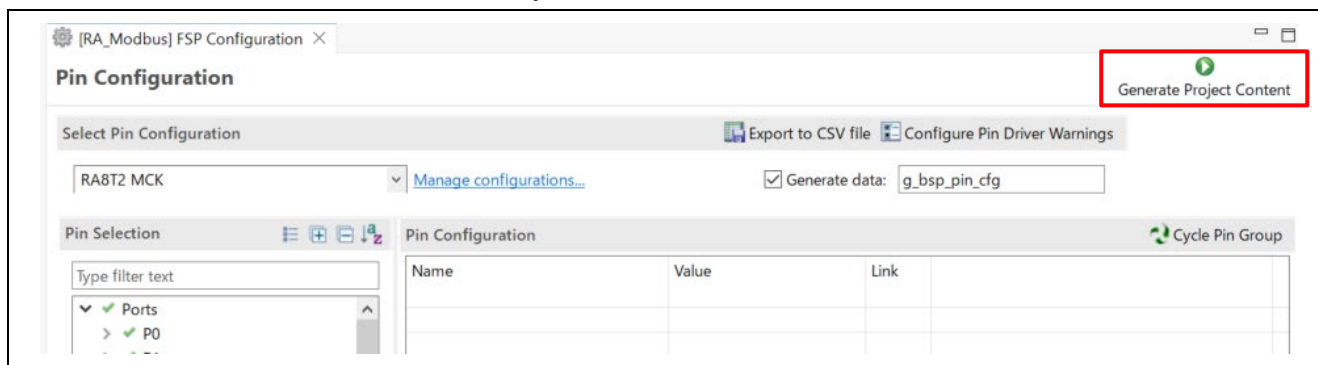
## 6. Set PHY Reset Terminals

Change the "Mode" of "Pins" → "Ports" → "P7" → "P708" to "Output mode (Initial High)".



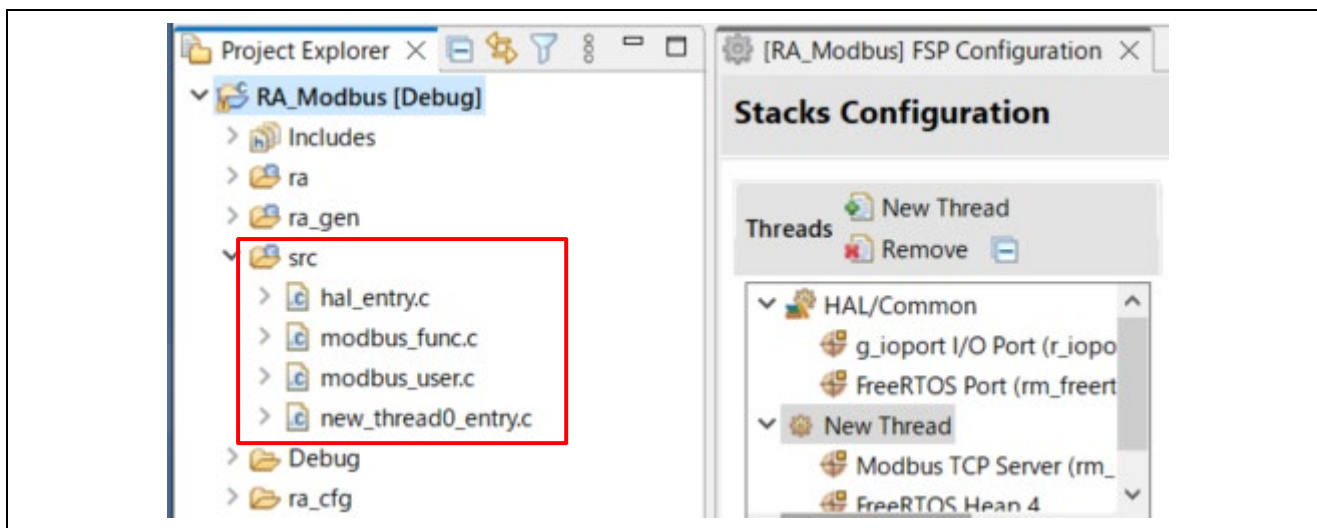
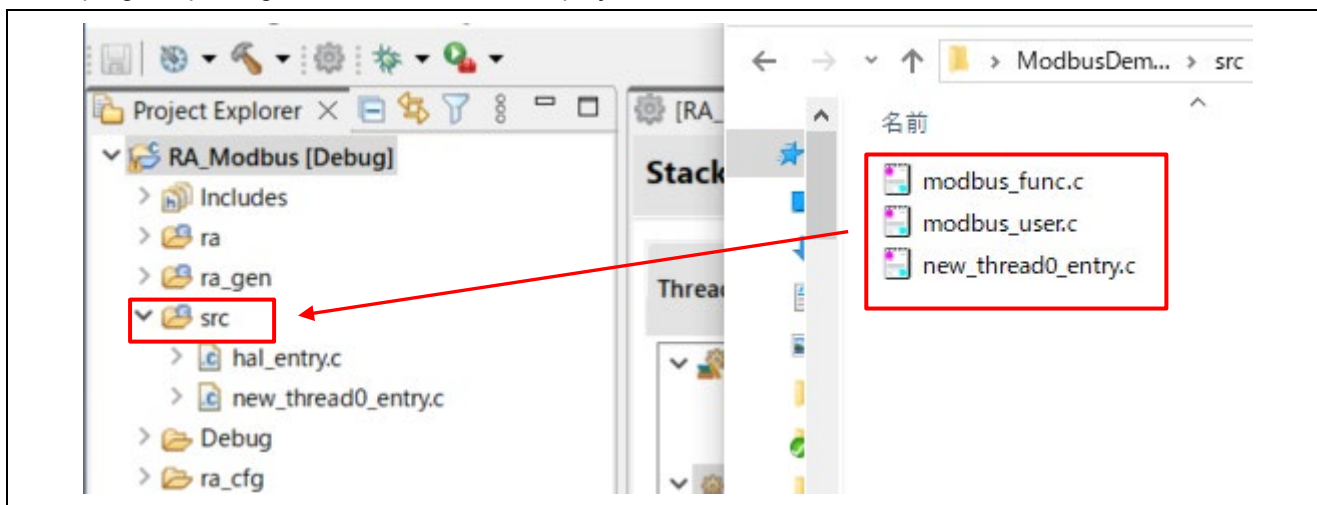
## 7. Generate the code

Generate the code with "Generate Project Content".



## 8. Add Modbus Sample Application

Copy modbus\_func.c, modbus\_user.c, and new\_thread0\_entry.c from the src folder of the sample program package to the src folder of the project and overwrite them.

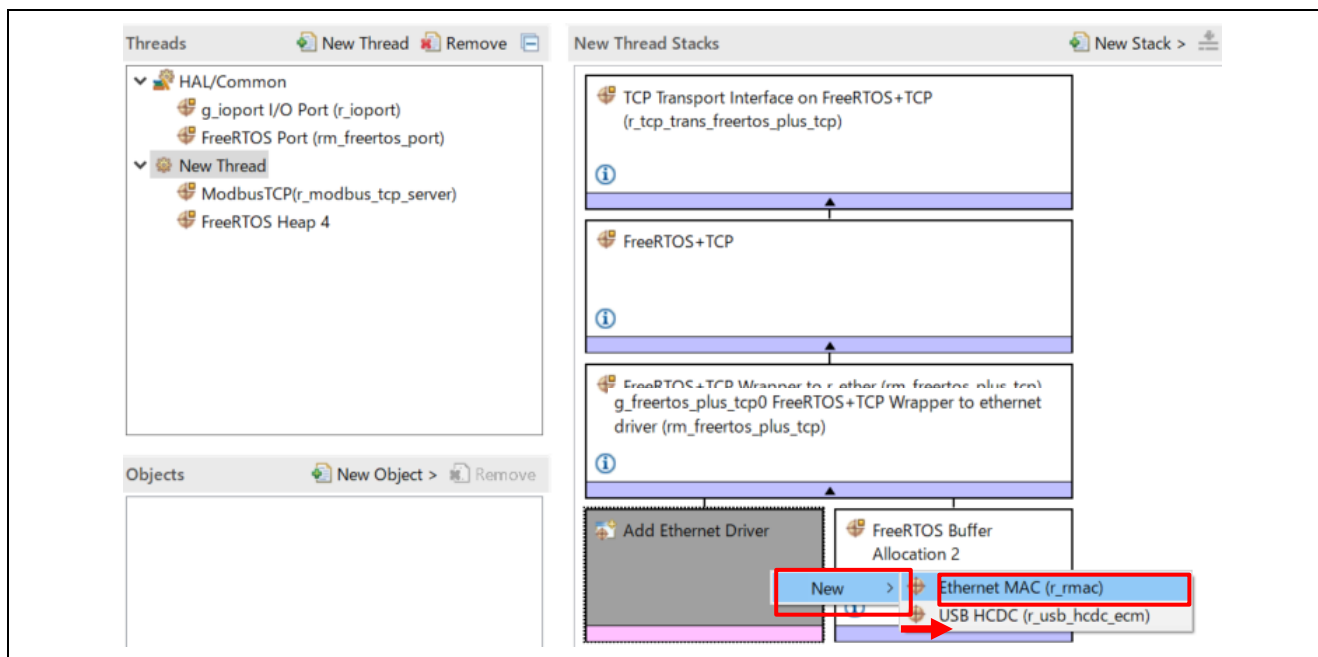


## 6.2.5 EK-RA8P1 Creating Procedures

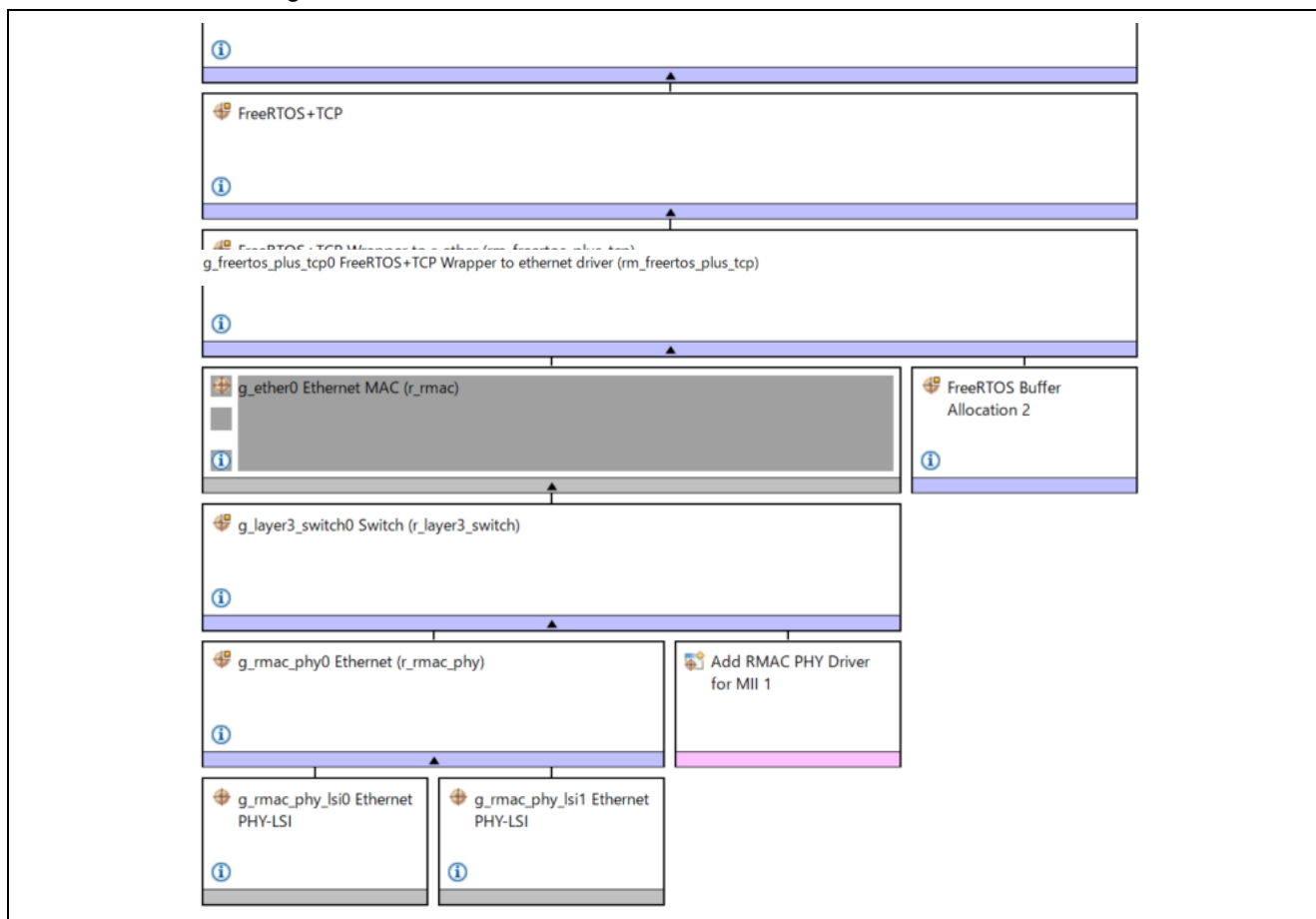
This section describes the procedures for creating EK-RA8P1.

### 1. Add Ethernet Driver

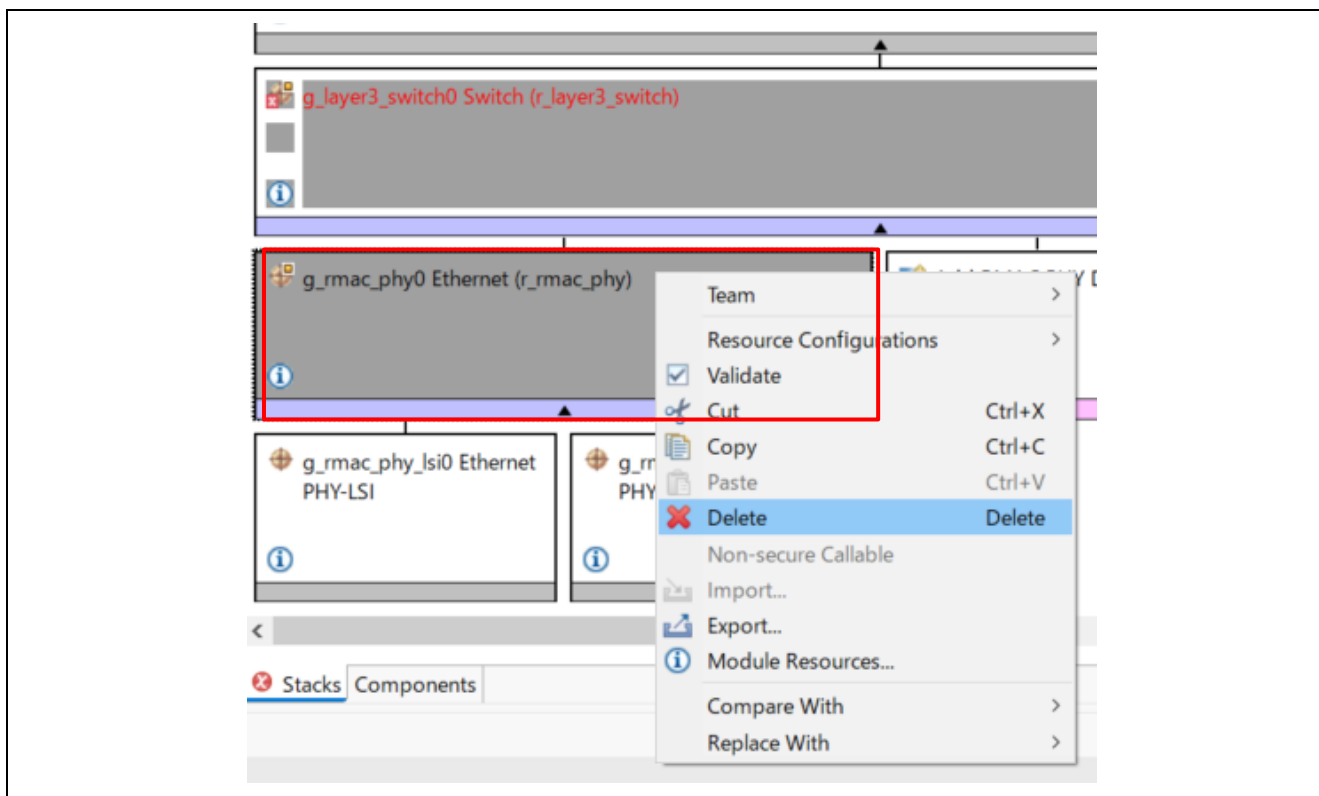
Click “New” → “Ethernet (r\_rmac)” to “Add Ethernet Driver”.



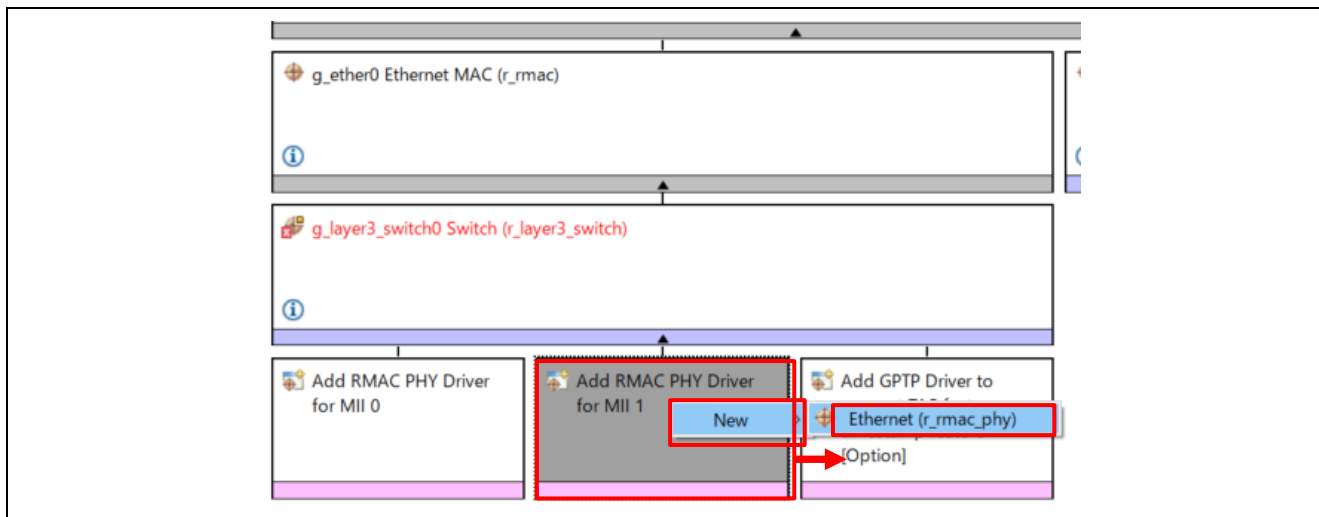
The stack will be configured as follows:



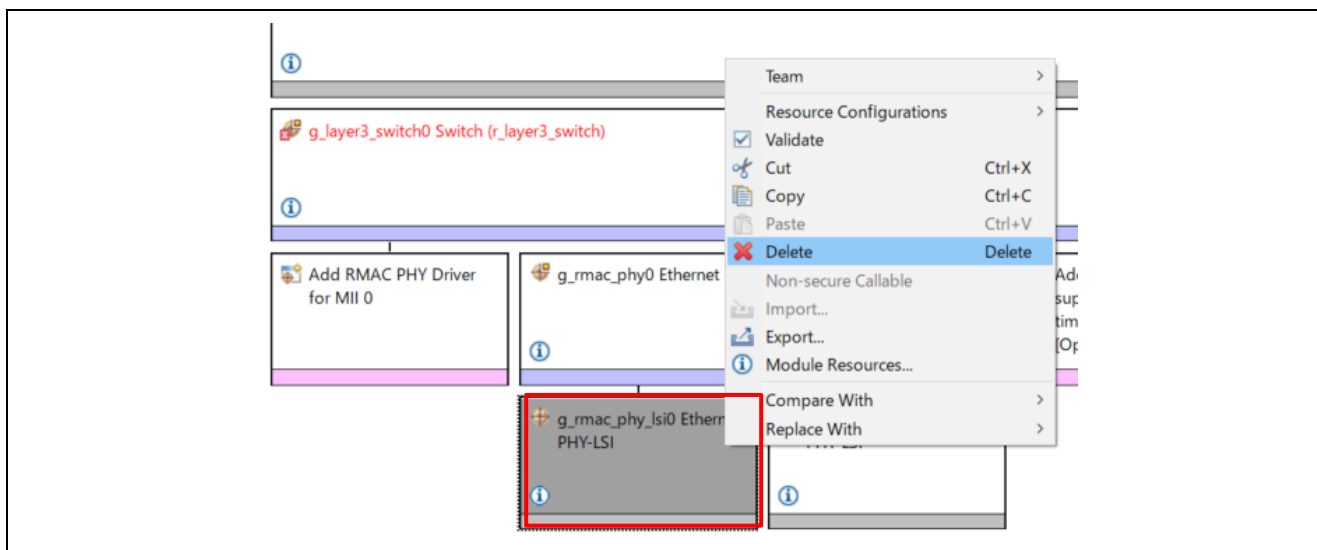
Right-click on “g\_mac\_phy0 Ethernet (r\_rmac\_phy)”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.



Click “New” → “Ethernet (r\_rmac\_phy)” to “Add RMAC PHY Driver for MII1”.



Right-click on “g\_rmac\_phy\_Isi0 Ethernet PHY-LSI”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.





2. Set r\_rmac
- Open “Properties” of “g\_ether0 Ethernet MAC (r\_rmac)” in “Stacks” and change “Channel” and “Promiscuous Mode” in “Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)” to the following values.

Channel : **1**

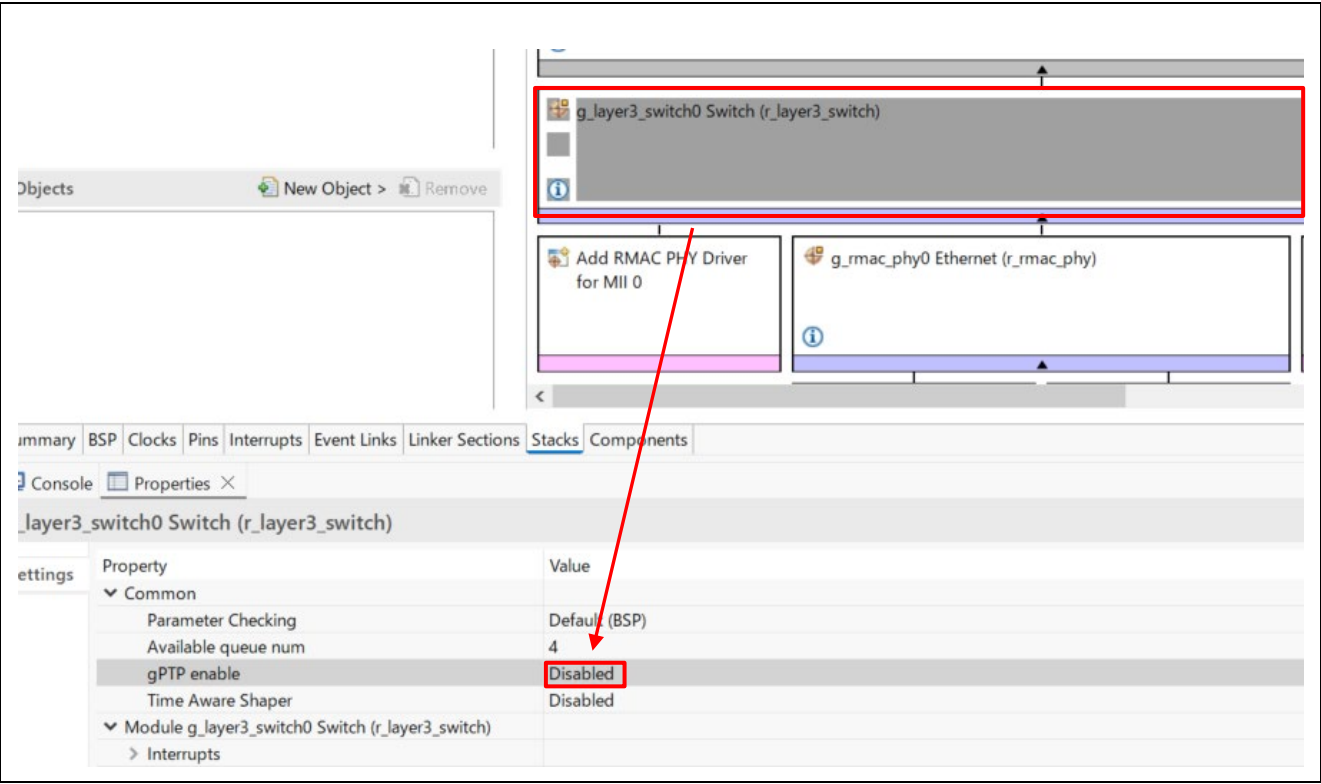
Promiscuous Mode : **Enable**

The screenshot shows the Renesas RA IDE interface. On the left, the 'Objects' pane lists several components: FreeRTOS Port (rm\_freertos\_port), New Thread, ModbusTCP(r\_modbus\_tcp\_server), and FreeRTOS Heap 4. The main workspace displays a stack of components: g\_ether0 Ethernet MAC (r\_rmac) at the top, followed by g\_layer3\_switch0 Switch (r\_layer3\_switch). The 'g\_ether0 Ethernet MAC (r\_rmac)' component is highlighted with a red box. Below the workspace, the 'Properties' window is open for the 'g\_ether0 Ethernet MAC (r\_rmac)' component. The 'Properties' window has tabs for 'Primary', 'BSP', 'Clocks', 'Pins', 'Interrupts', 'Event Links', 'Linker Sections', 'Stacks', and 'Components'. The 'Stacks' tab is selected. The 'Properties' window shows a table of properties and their values:

Property	Value
▼ Common	
Parameter Checking	Default (BSP)
▼ Module g_mac_phy0 Ethernet (r_rmac_phy)	
▼ General	
Name	g_ether0
Channel	1
Zero-copy Mode	Disable
Flow control functionality	Disable
MAC address	00:11:22:33:44:55
▼ Filters	
Multicast Mode	Enable
Promiscuous Mode	Enable
Broadcast filter	0

3. Set r\_layer3\_switch  
Open “Properties” of “g\_layer3\_switch0 Switch (r\_layer3\_switch)” in “Stacks” and change “gPTP enable” to the following values.

gPTP enable : **Disabled**



## 4. Set r\_rmac\_phy

Open "Properties" of "g\_mac\_phy0 Ethernet (r\_rmac\_phy)" in "Stacks" and change "Channel", "Default PHY-LSI port" and "Select MII type" in "Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)" to the following values.

Channel : 1

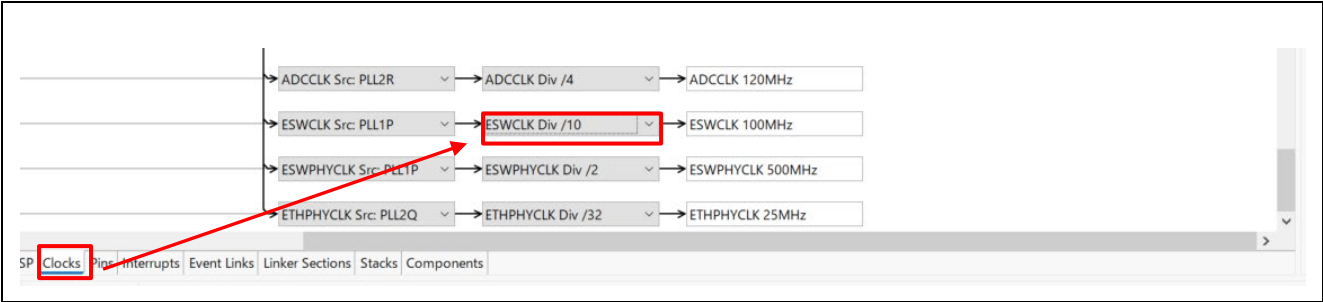
Default PHY-LSI port : 1

Select MII type : **RGMII**

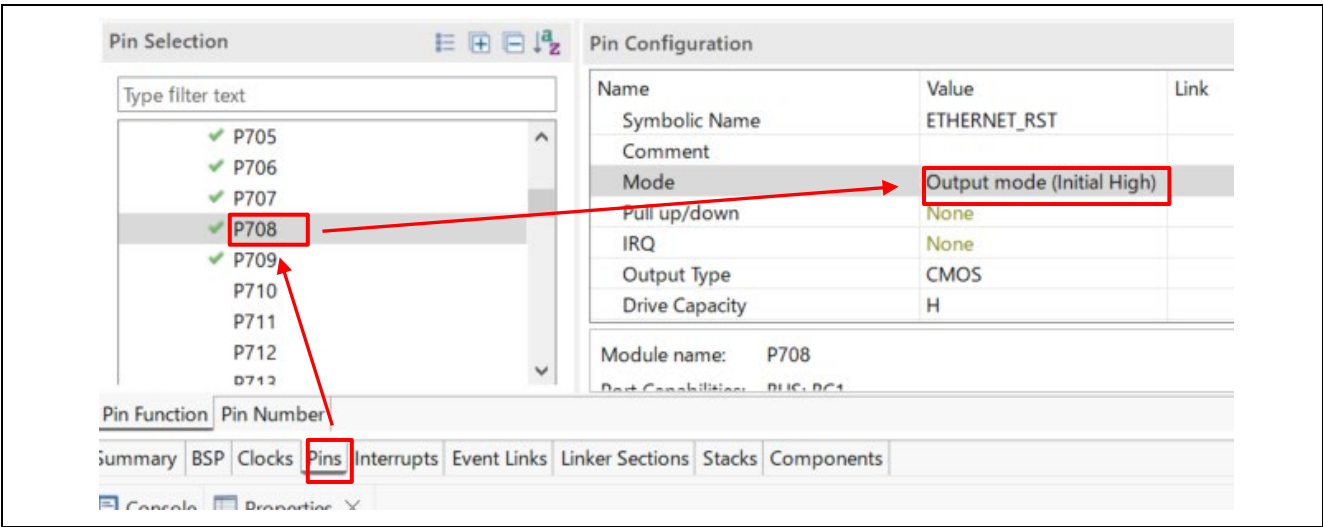
The screenshot shows the development environment with the 'Stacks' tab selected. The 'g\_mac\_phy0 Ethernet (r\_rmac\_phy)' component is highlighted in the 'Stacks' view. The 'Properties' window for this component is open, showing the 'Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)' section. The 'Select MII type' property is set to 'RGMII'. A red arrow points from the component in the 'Stacks' view to the 'Select MII type' property in the 'Properties' window.

Property	Value
Parameter Checking	Default (BSP)
KSZ8091RNB Target	Disabled
KSZ8041 Target	Disabled
DP83620 Target	Disabled
ICS1894 Target	Disabled
GPY111 Target	Disabled
User Own Target	Disabled
Reference Clock	Default
Module g_mac_phy0 Ethernet (r_rmac_phy)	
Name	g_rmac_phy0
Channel	1
Default PHY-LSI port	1
PHY-LSI Reset Completion Timeout	0x00020000
Select MII type	RGMII
Port Custom Init Function	NULL
Port Custom Link Partner Ability Get Function	NULL
Flow Control	Disable
Management frame format	Clause 22 frame format
MDC clock rate (Hz)	2500000
MDIO hold timing adjustment	0
MDIO capture timing adjustment	0

5. Set ESW Clock  
Change the "ESWCLK Div" at the bottom of "Clocks" to "ESWCLK Div /10".

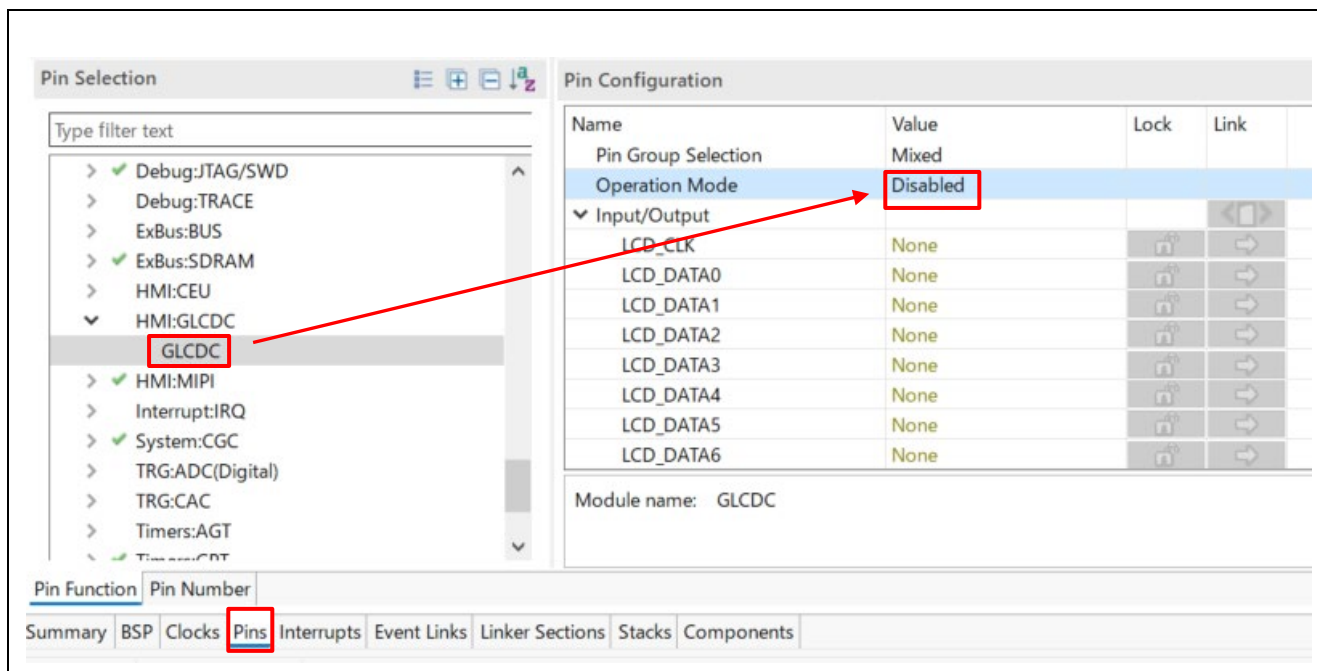


6. Set PHY Reset Terminals  
Change the "Mode" of "Pins" → "Ports" → "P7" → "P708" to "Output mode (Initial High)".



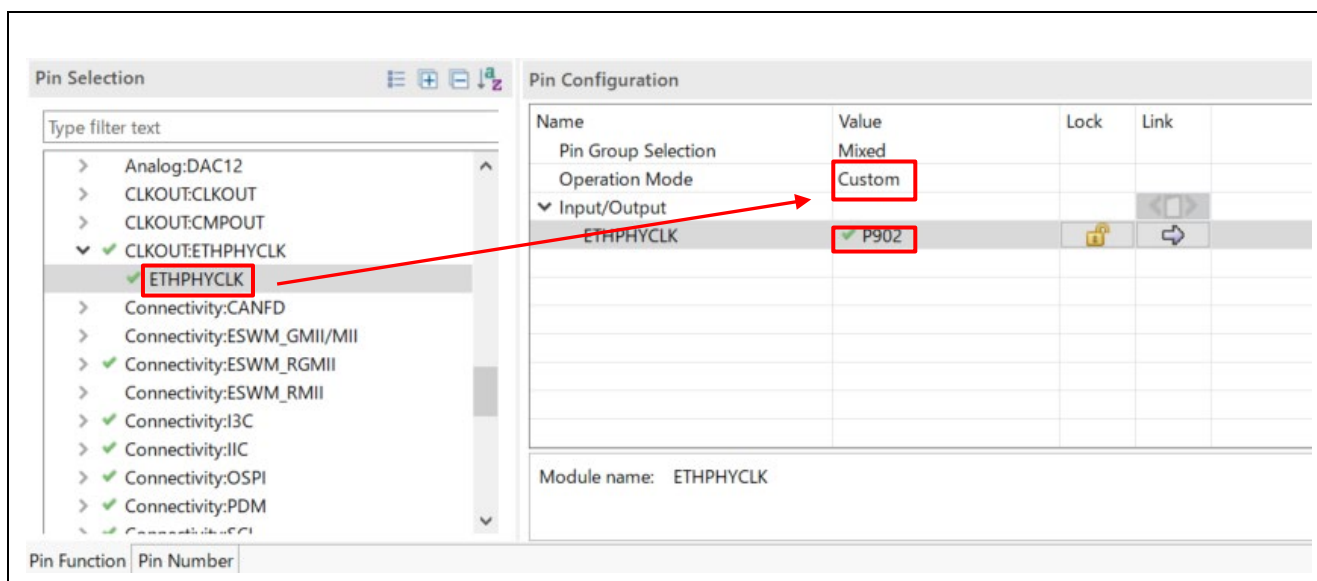
## 7. Set PHY Clock Terminals

Change the "Operation Mode" of "Pins" → "Peripherals" → " HMI: GLCDC " → " GLCDC " to "Disabled".

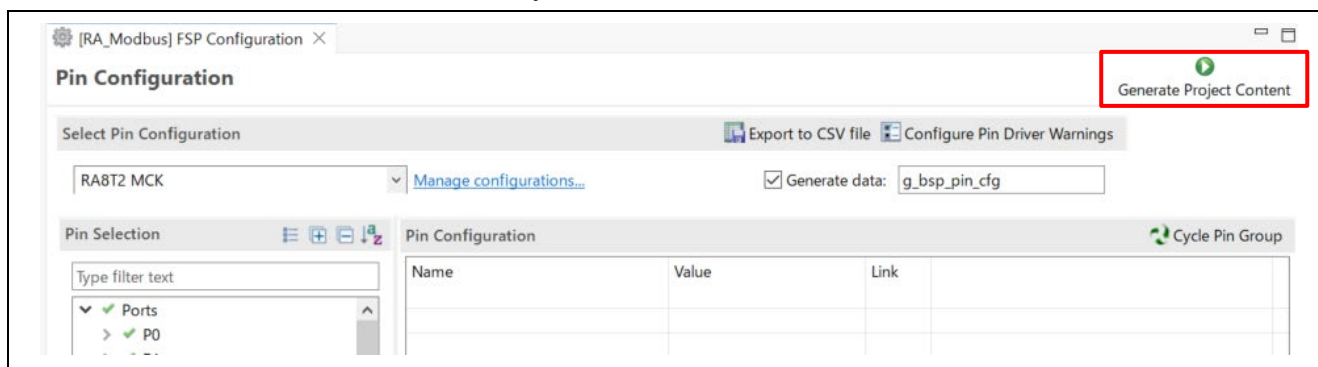


After changing the "Operation Mode" of "Pins" → "Peripherals" → " CLKOUT: ETHPHYCLK " → " ETHPHYCLK " to "Custom", change the pins as follows:

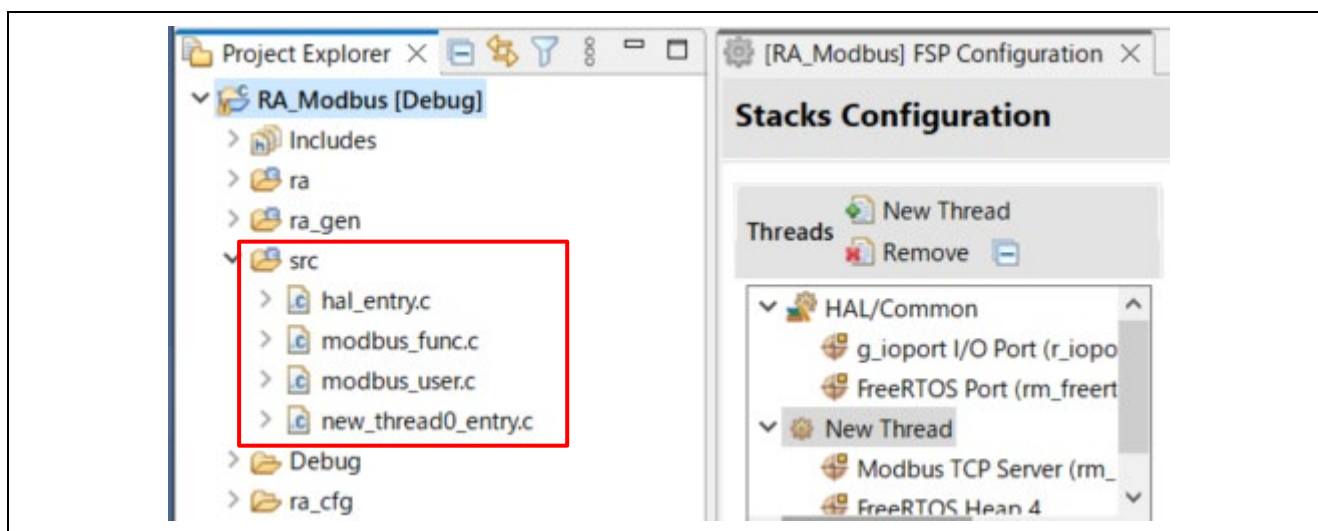
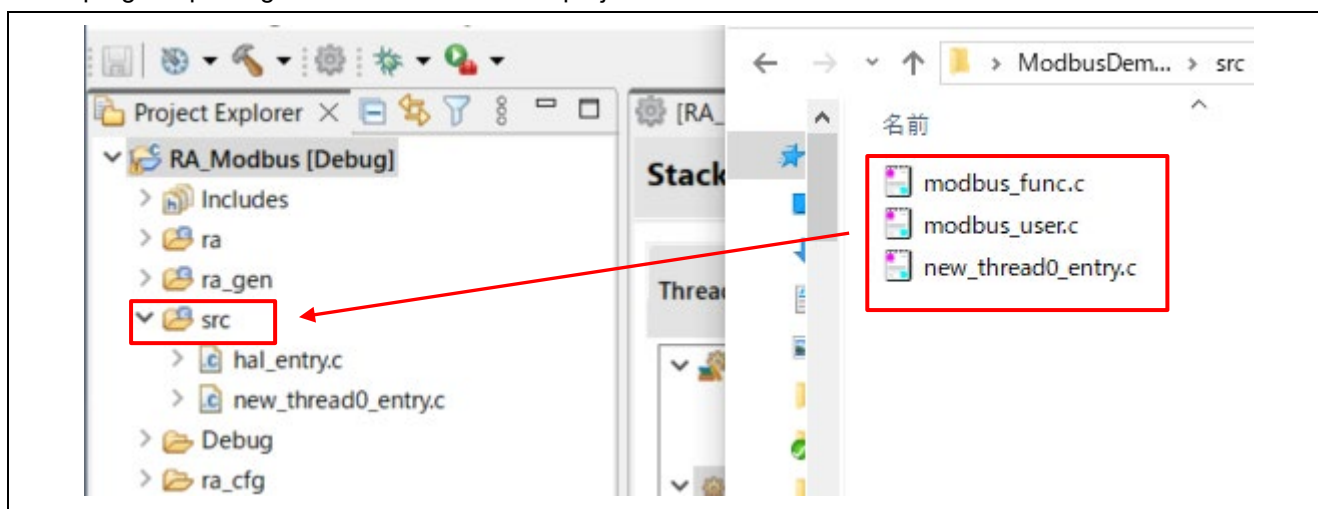
ETHPHYCLK : **P902**



8. Generate the code  
Generate the code with "Generate Project Content".



9. Add Modbus Sample Application  
Copy modbus\_func.c, modbus\_user.c, and new\_thread0\_entry.c from the src folder of the sample program package to the src folder of the project and overwrite them.

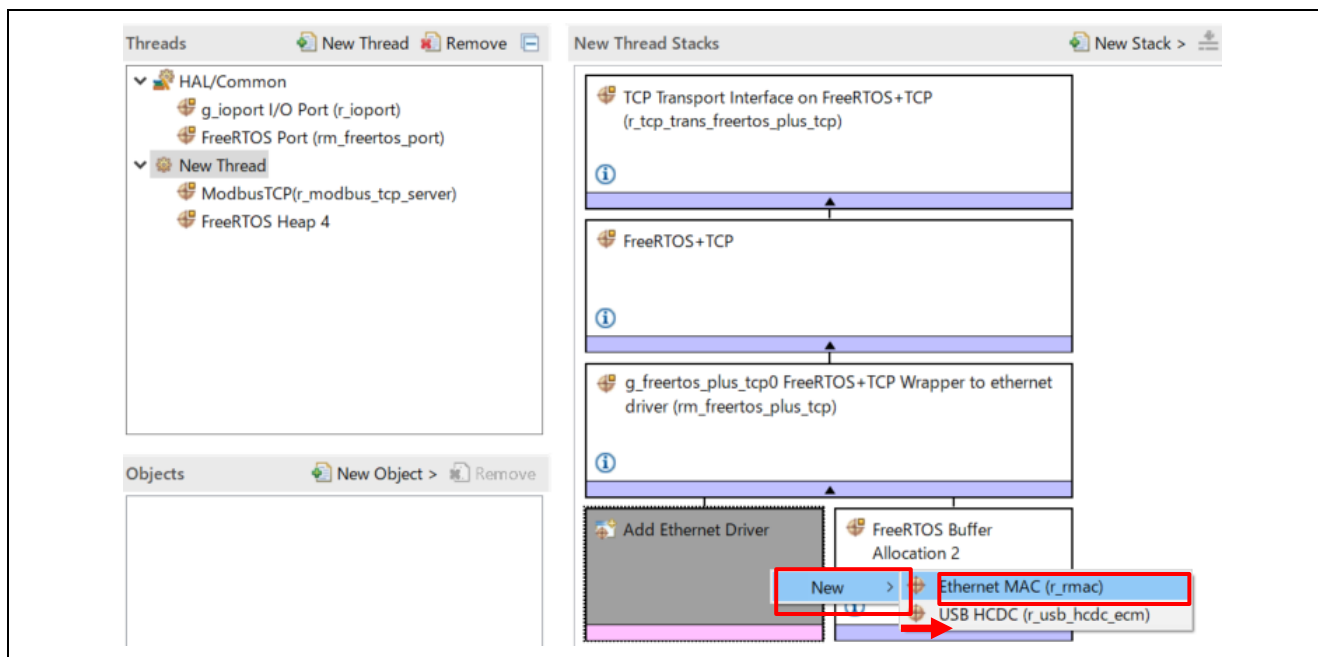


## 6.2.6 EK-RA8M2 Creating Procedures

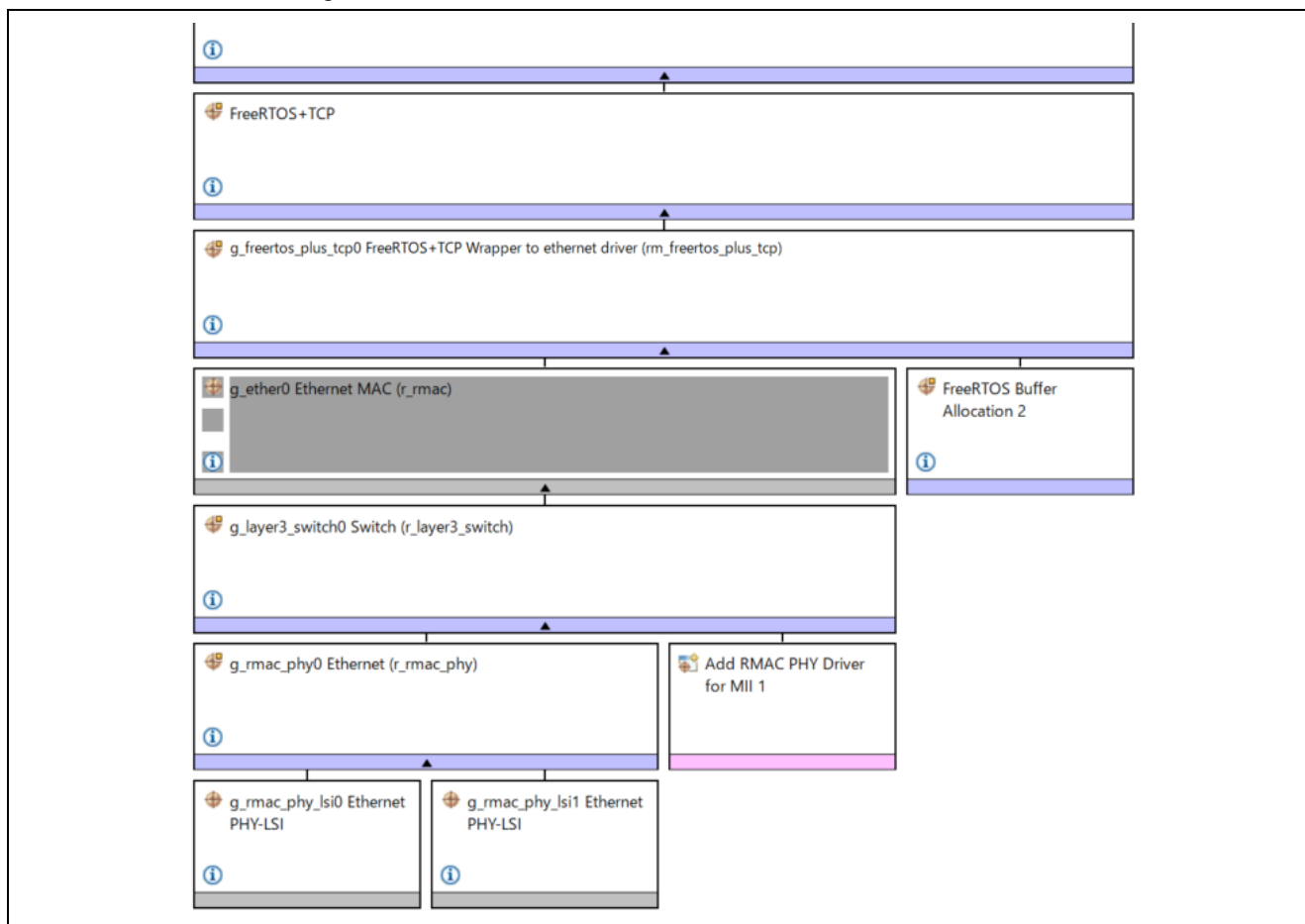
This section describes the procedures for creating EK-RA8M2.

### 1. Add Ethernet Driver

Click “New” → “Ethernet (r\_rmac)” to “Add Ethernet Driver”.

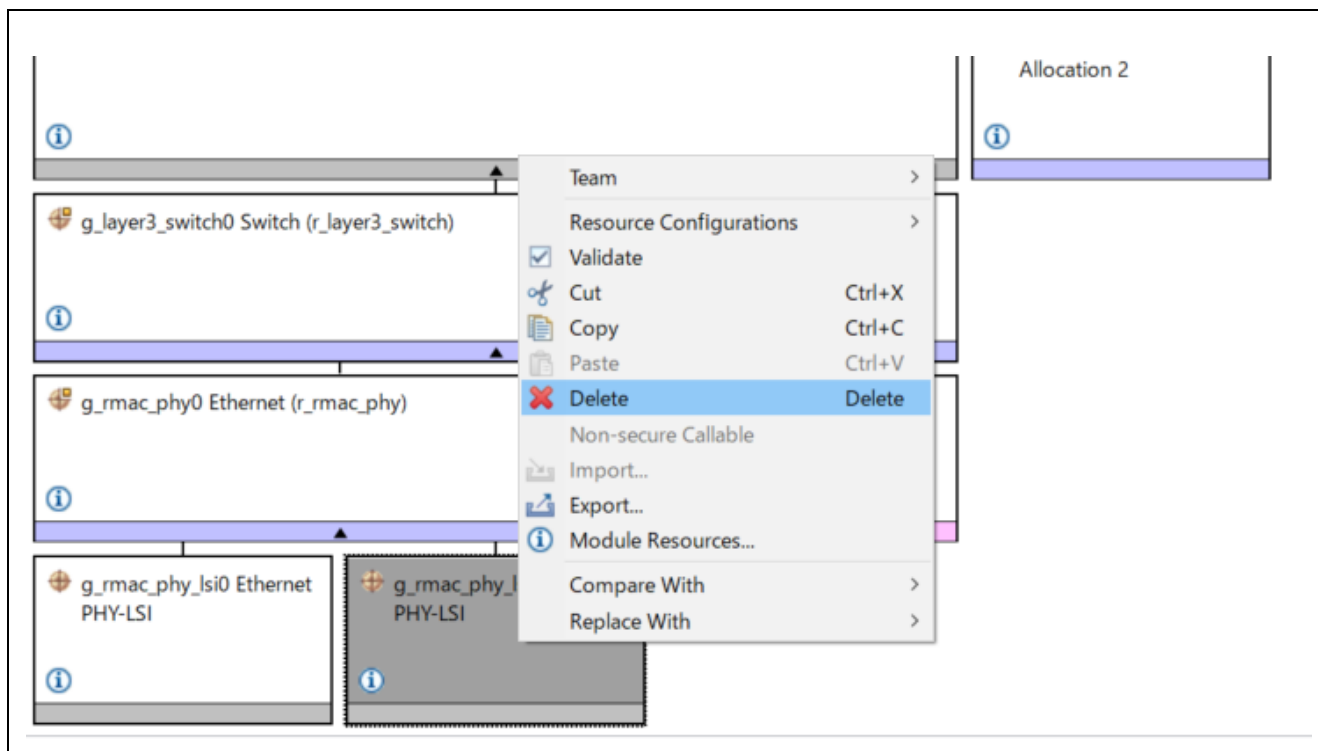


The stack will be configured as follows:



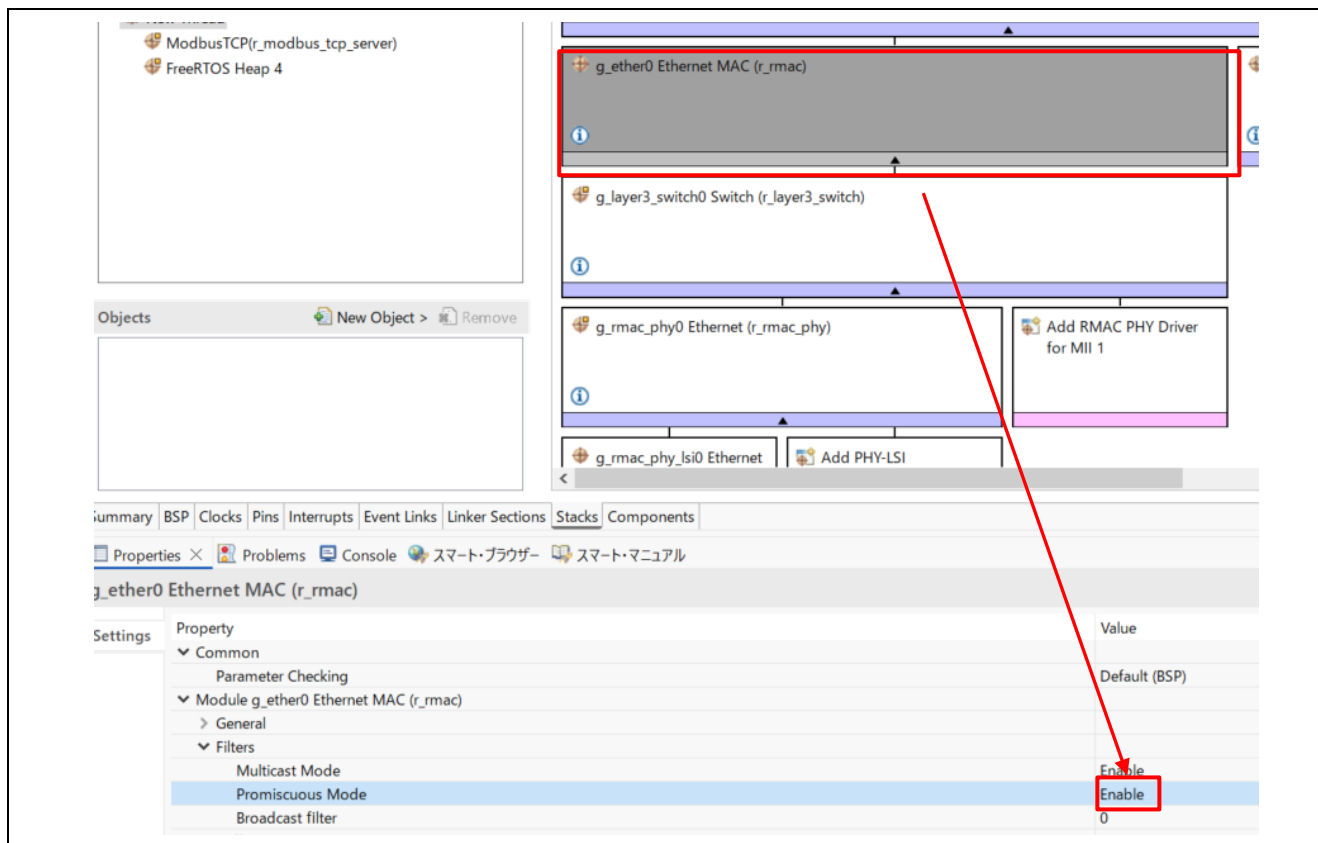


Right-click on “g\_rmac\_phy\_lsi0 Ethernet PHY-LSI”, select Delete, and then click “OK” on the “Remove Stack Elements” pop-up.



## 2. Set r\_rmac

Change the “Stacks” → “g\_ether0 Ethernet MAC (r\_rmac)” → “Module g\_ether0 Ethernet MAC (r\_rmac)” → “Promiscuous Mode” in “Filters” to “Enable”.





3. Set `r_layer3_switch`  
Open "Properties" of "g\_layer3\_switch0 Switch (r\_layer3\_switch)" in "Stacks" and change "gPTP enable" to the following values.

gPTP enable : **Disabled**

The screenshot shows the configuration tool interface. On the left, a tree view lists components: HAL/Common, g\_ioport I/O Port (r\_ioport), FreeRTOS Port (rm\_freertos\_port), New Thread, ModbusTCP(r\_modbus\_tcp\_server), and FreeRTOS Heap 4. The main area displays a stack diagram with components: g\_layer3\_switch0 Switch (r\_layer3\_switch), g\_rmac\_phy0 Ethernet (r\_rmac\_phy), g\_rmac\_phy\_0 Ethernet PHY-LSI, and Add PHY-LSI configuration for MII 1. A red box highlights the 'g\_layer3\_switch0 Switch (r\_layer3\_switch)' component, and a red arrow points from it to the 'Properties' window.

The 'Properties' window for 'g\_layer3\_switch0 Switch (r\_layer3\_switch)' is shown below the stack diagram. It has tabs for 'Console' and 'Properties'. The 'Properties' tab is active, showing a table of properties and their values.

Property	Value
Common	
Parameter Checking	Default (BSP)
Available queue num	4
gPTP enable	Disabled
Time Aware Shaper	Disabled
Module g_layer3_switch0 Switch (r_layer3_switch)	

## 4. Set r\_rmac\_phy

Open “Properties” of “g\_mac\_phy0 Ethernet (r\_rmac\_phy)” in “Stacks” and change “Select MII type”, “MDIO hold timing adjustment” and “MDIO capture timing adjustment” in “Module g\_mac\_phy0 Ethernet (r\_rmac\_phy)” to the following values.

Select MII type : **RGMII**

MDIO hold timing adjustment : **1**

MDIO capture timing adjustment : **1**

Settings	Value
KSZ8091RNB Target	Disabled
KSZ8041 Target	Disabled
DP83620 Target	Disabled
ICS1894 Target	Disabled
GPY111 Target	Disabled
User Own Target	Disabled
Reference Clock	Default
Module g_mac_phy0 Ethernet (r_rmac_phy)	
Name	g_mac_phy0
Channel	0
Default PHY-LSI port	0x00020000
PHY-LSI Reset Completion Timeout	0x00020000
Select MII type	<b>RGMII</b>
Port Custom Init Function	NULL
Port Custom Link Partner Ability Get Function	NULL
Flow Control	Disable
Management frame format	Clause 22 frame format
MDC clock rate (Hz)	2500000
MDIO hold timing adjustment	<b>1</b>
MDIO capture timing adjustment	<b>1</b>

## 5. Set ESW Clock

Change the “ESWCLK Div” at the bottom of “Clocks” to “ESWCLK Div /10”.

Source	Div	Frequency
OCTACLK Src: PLL1Q	OCTACLK Div /1	OCTACLK ~333.333MHz
ADCCLK Src: PLL2R	ADCCLK Div /4	ADCCLK 120MHz
ESWCLK Src: PLL1P	<b>ESWCLK Div /10</b>	ESWCLK 100MHz
ESWPHYCLK Src: PLL1P	ESWPHYCLK Div /2	ESWPHYCLK 500MHz
ETHPHYCLK Src: PLL2Q	ETHPHYCLK Div /32	ETHPHYCLK 25MHz
ESCCLK Src: PLL2Q	ESCCLK Div /8	ESCCLK 100MHz

## 6. Set PHY Reset Terminals

Change the "Mode" of "Pins" → "Ports" → "P5" → "P514" to "Output mode (Initial High)".

The screenshot displays the Renesas RA Pin Configuration tool interface. On the left, the 'Pin Selection' pane shows a tree view of pins under 'P5'. Pin 'P514' is selected and highlighted with a red box. A red arrow points from this box to the 'Mode' field in the 'Pin Configuration' table on the right. The 'Mode' field is also highlighted with a red box and contains the text 'Output mode (Initial High)'. Below the 'Pin Configuration' table, the 'Module name' is 'P514' and 'Port Capabilities' are listed as 'ESWM\_GMII/MII: ET\_TAS\_STA1' and 'ESWM\_RGMII: ET\_TAS\_STA1'. At the bottom, the 'Pin Function' tab is active, and the 'Pins' sub-tab is selected, also highlighted with a red box. A red arrow points from this sub-tab to the 'P514' pin in the selection list.

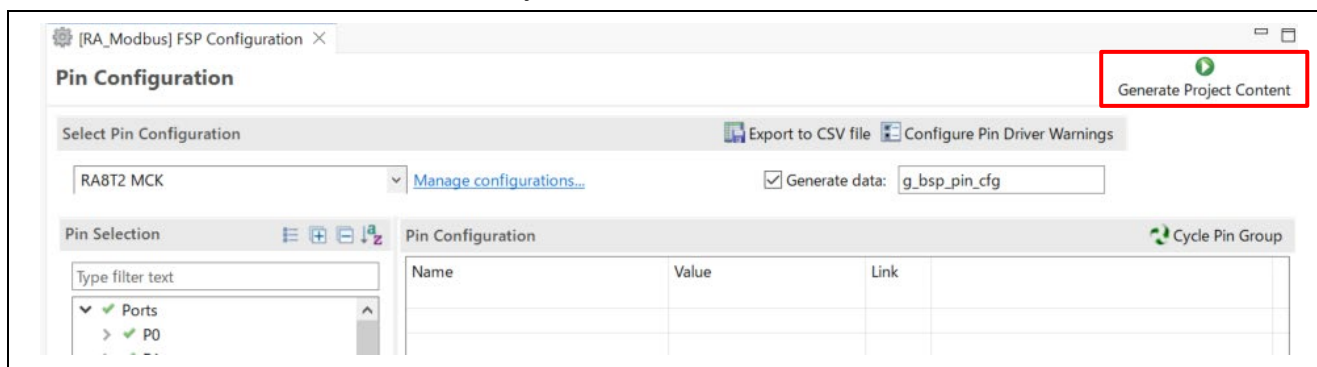
Name	Value	Link
Symbolic Name	ETH_RSTN	
Comment		
Mode	Output mode (Initial High)	
Pull up/down	None	
IRQ	None	
Output Type	CMOS	
Drive Capacity	L	
Input Latch	None	
Input/Output		
P514	✓ GPIO	

Module name: P514  
Port Capabilities: ESWM\_GMII/MII: ET\_TAS\_STA1  
ESWM\_RGMII: ET\_TAS\_STA1

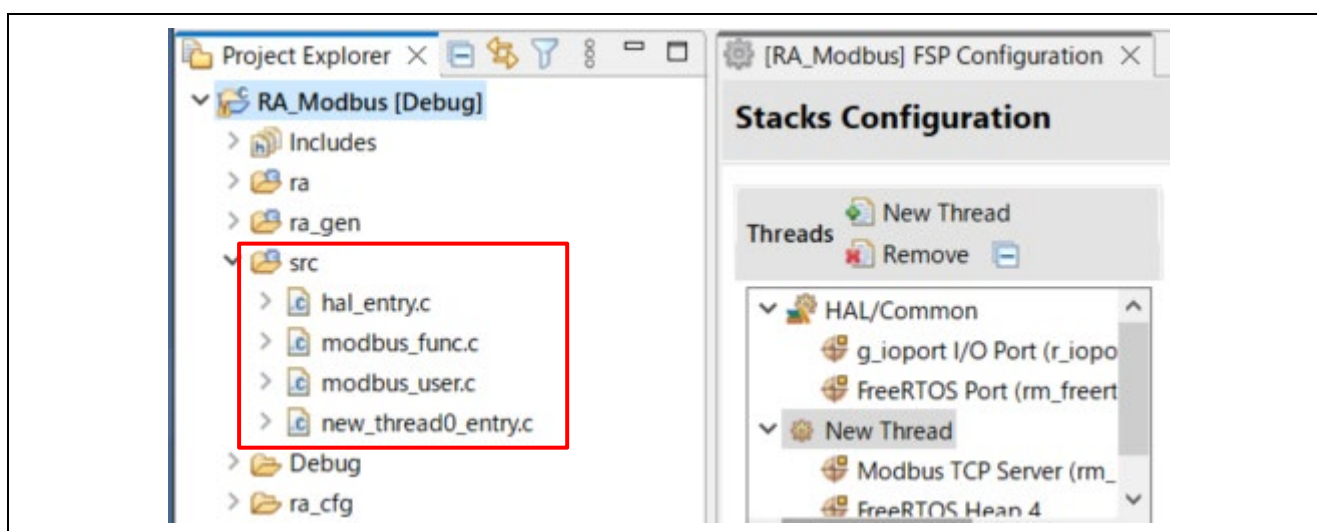
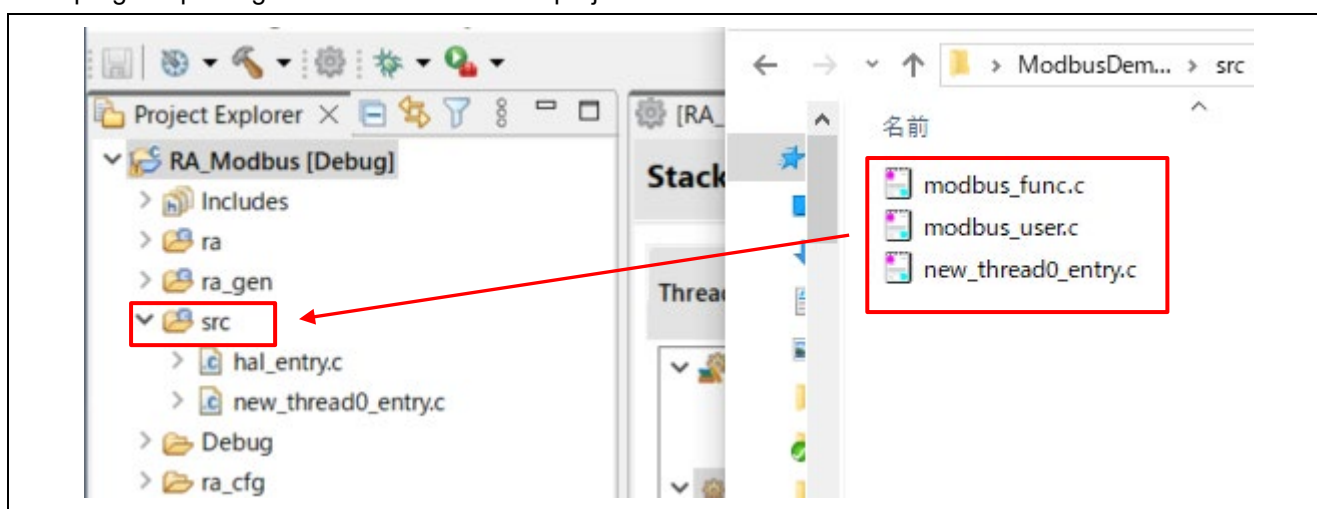
Pin Function: Pin Number

Summary | BSP | Clocks | Pins | Interrupts | Event Links | Linker Sections | Stacks | Components

7. Generate the code  
Generate the code with "Generate Project Content".



8. Add Modbus Sample Application  
Copy modbus\_func.c, modbus\_user.c, and new\_thread0\_entry.c from the src folder of the sample program package to the src folder of the project and overwrite them.

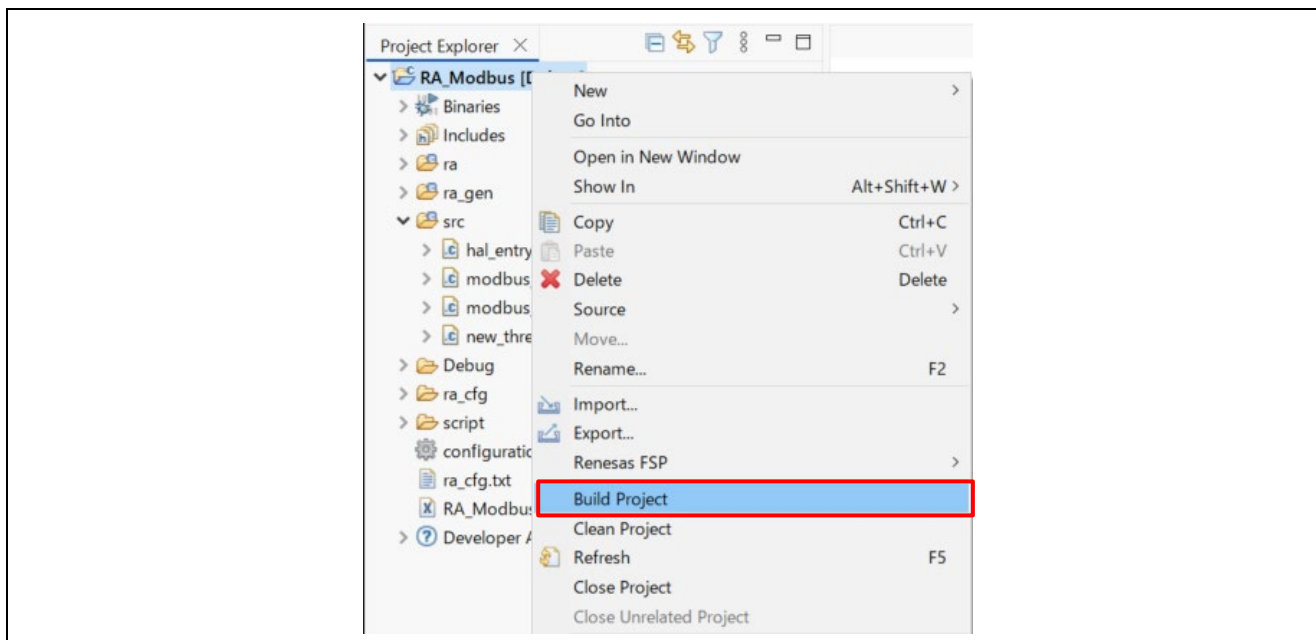


## 7. Execution of Modbus Sample Project

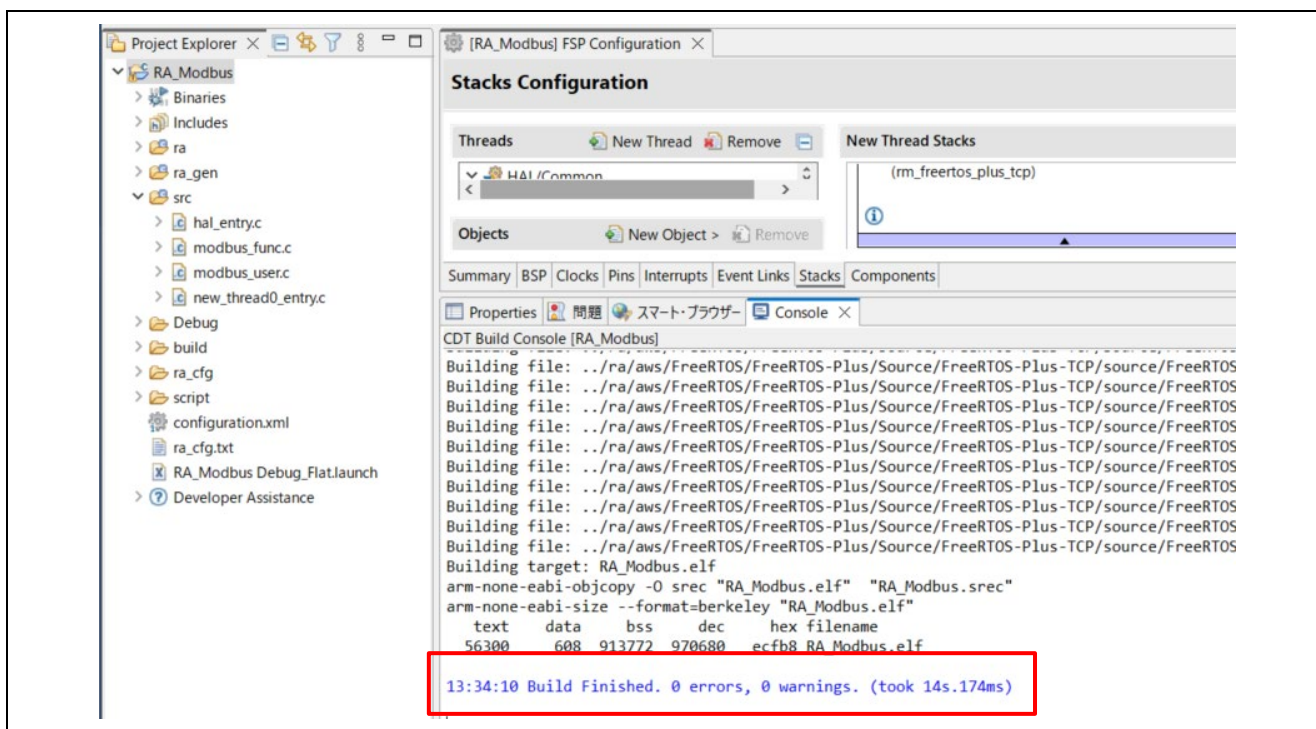
Before you begin, read "[5. Evaluation Board Connection Setup](#)" to complete the hardware connections. Also, read "[6. Setting Up the Modbus Sample Project](#)" to complete the preparation of the Modbus sample project.

### 1. Build the project

Right-click on the project from the "Project Explorer", then select "Build Project".

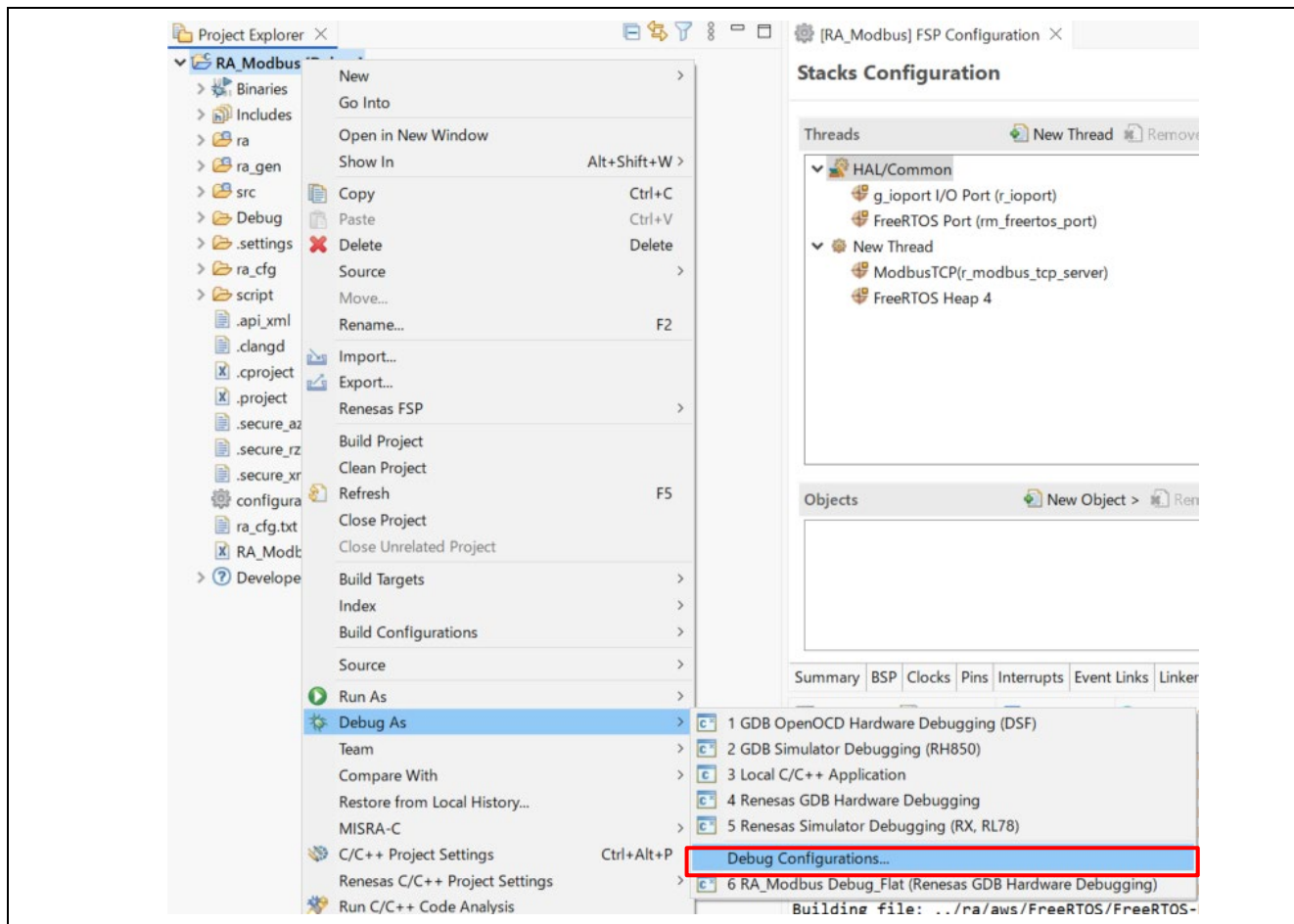


At this time, make sure there are no build errors.



- Download the application and run the debugger.  
To start debugging, follow the steps below:

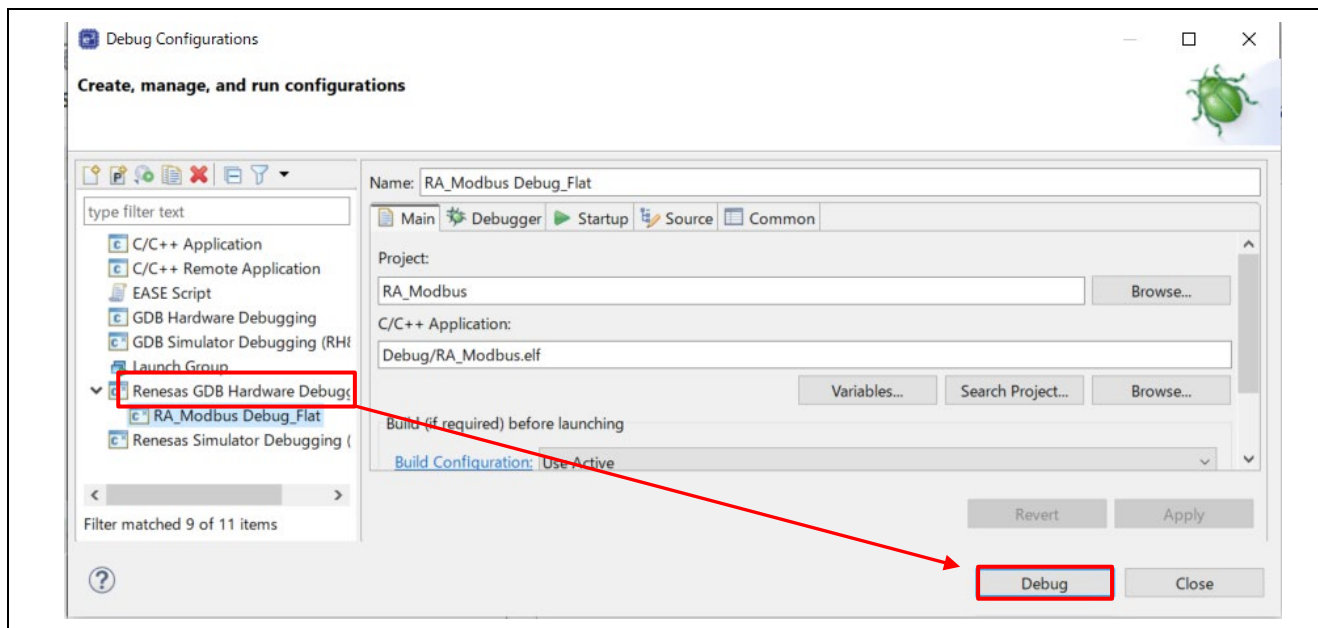
In “Project Explorer” view, right-click on the project to be debugged and select “Debug As” → “Debug Configurations”.



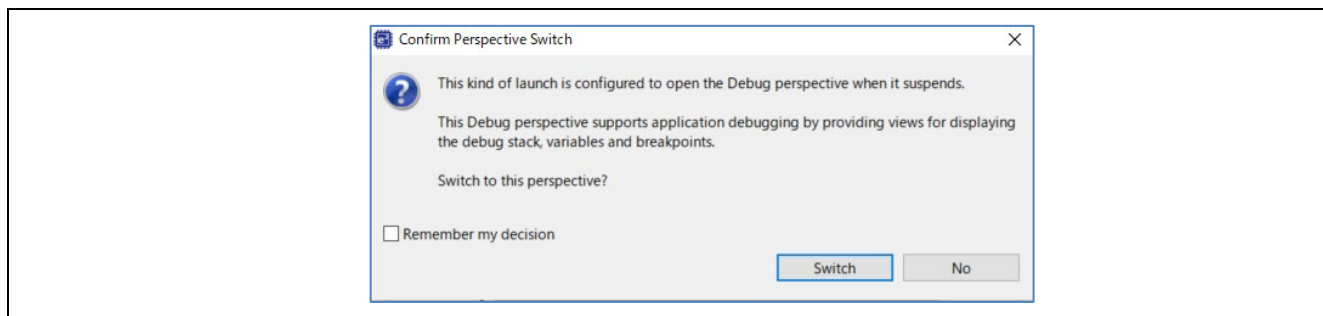


## 3. Program download.

Select “Renesas GDB Hardware Debugging” → “xxxxx Debug\_Flat”, then click “Debug”.



The following dialog appears. Switch to the debug screen.

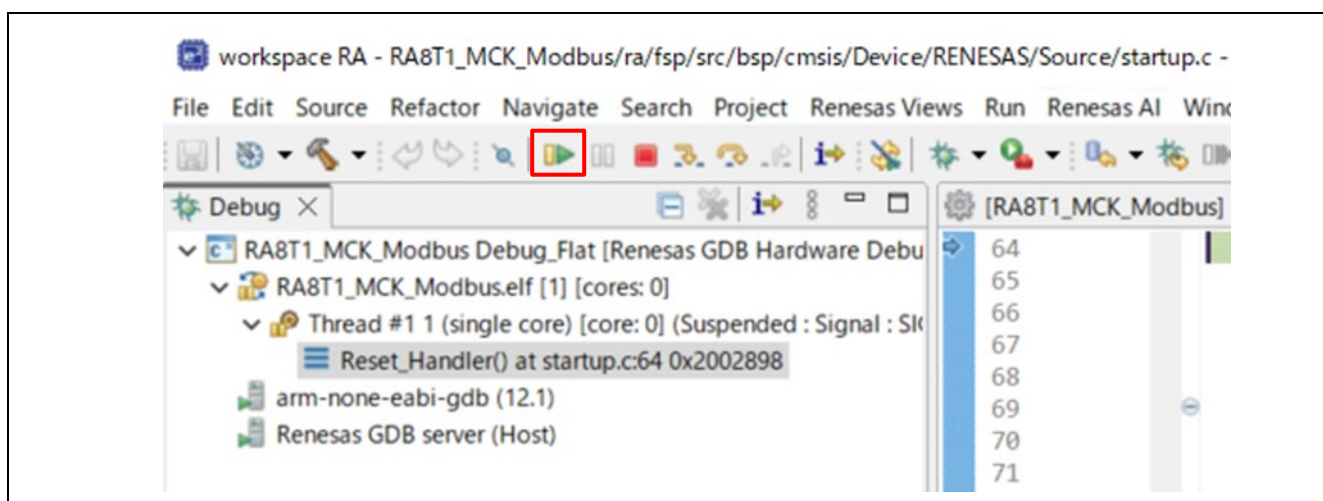


## 4. Program starts.

Click the **Resume** button.

When debugging starts, the program is suspended at main.c.

Click the **Resume** button again to run the program.



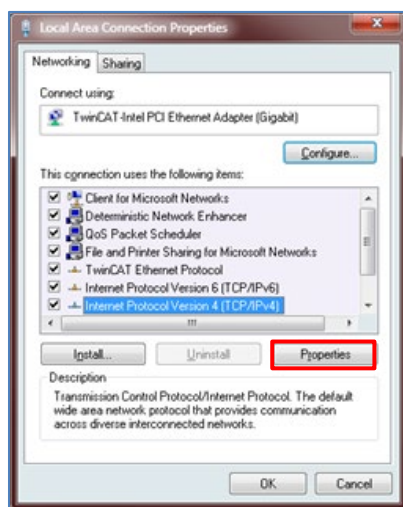
## 8. Modbus Communication Using Modbus Demo Application

This section demonstrates the procedure for checking the demo operation of the Modbus sample application using the Modbus demo application. For information on configuring the Modbus protocol stack, see "9.1. [Appendix A: Modbus Protocol Stack Configuration](#)".

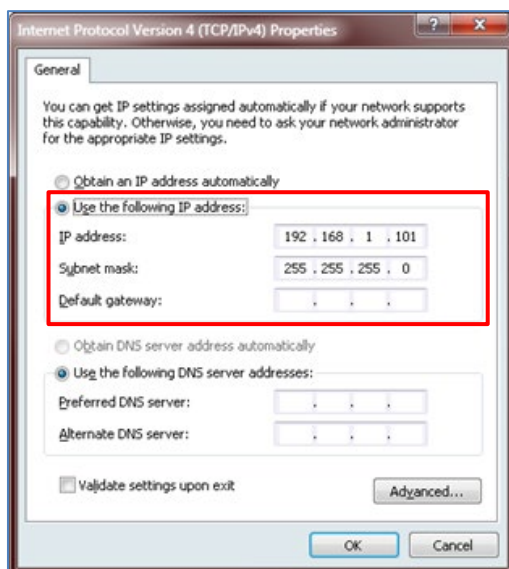
### 8.1 IP Address Setting

To run the Modbus sample application, it is necessary to set the IP address of the PC running the evaluation tool, which is the client, to the same domain as the evaluation board.

1. Open the network connections list.  
**Control panel** → **Network and Sharing Center** → **Change adapter settings**.  
Double-click (or right-click) on the Local Area Connection, then select **Properties**.  
Select TCP/IPv4 and click the **Properties** button.



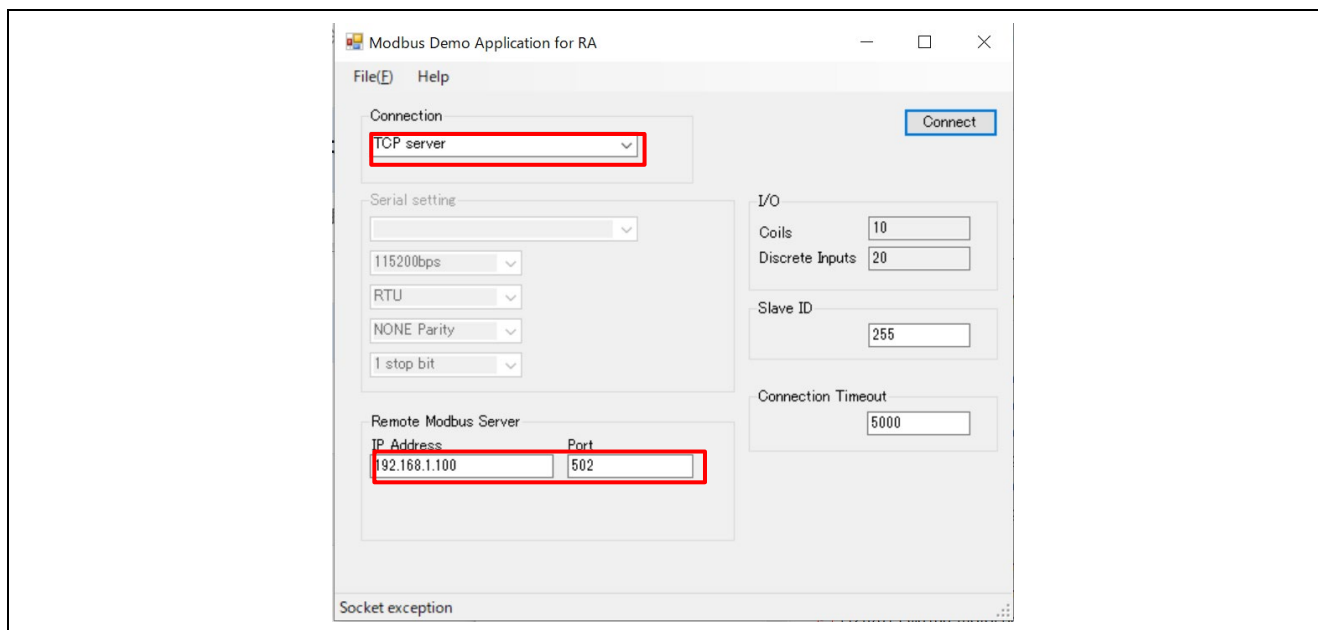
2. Set IP-address and subnet mask  
IP Address : 192.168.1.101, subnet mask : 255.255.255.0.



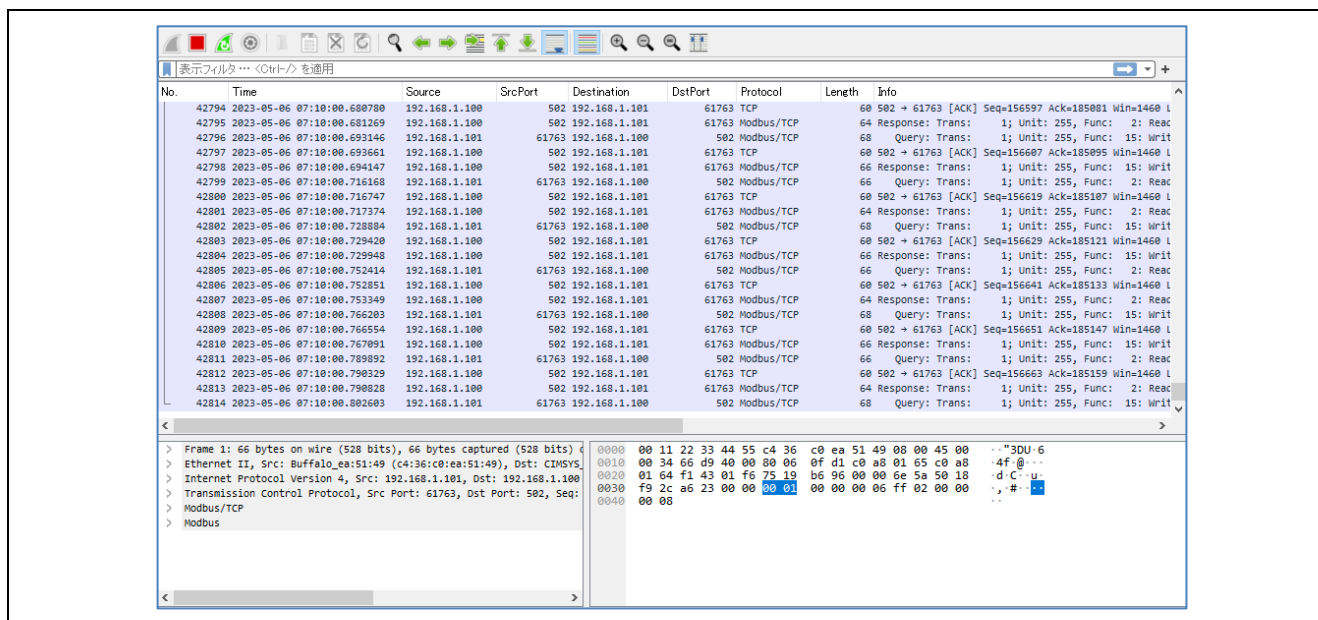


## 8.2 Setting up of Modbus Demo Application

1. Start "ModbusDemoApplication.exe" included in this sample program package.  
Under "Connection", select TCP Server and set the server IP address (for example, "192.168.1.100") and port number (for example, "502").



2. Click the **Connect** button. Once connected, the LED on the evaluation board should start blinking, indicating active Modbus communication.
3. Check the Modbus communication status by using a packet analysis tool like Wireshark.

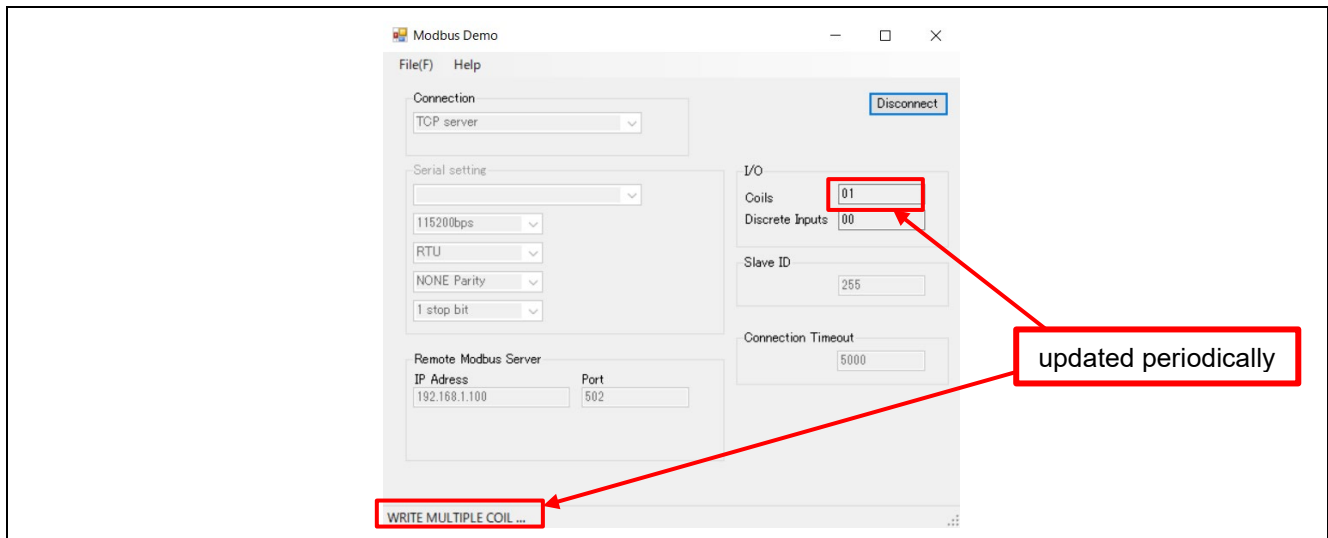


### 8.2.1 Modbus Demo Application Specification

The LED blinking can be controlled dynamically by communicating with the PC through the Modbus TCP protocol.

For this control, Read Coil and Write Coil function codes are used.

After clicking the "Connect" button, LEDs 1 to 3 will blink periodically.



## 9 Appendix

### 9.1 Appendix A: Modbus Protocol Stack Configuration

The Modbus protocol stack configuration is described below.

Configuration	Options	Default	Description
<b>Common</b>			
Parameter Checking	<ul style="list-style-type: none"> <li>• Default (BSP)</li> <li>• Enable</li> <li>• Disable</li> </ul>	Default (BSP)	If the selected code for parameter checking is included in the build.
Accept Task Stack Size	Legal values are 0x400 or higher.	0x400	Accept task stack size. Legal values are 0x400 or higher.
Accept Task Priority	Legal values range from 0 through (Max Priorities - 1)	2	Accept task priority. Legal values range from 0 through (Max Priorities - 1). Also, set Accept Task, Receive Task, and Service Task with the same priority.
Receive Task Stack Size	Legal values are 0x400 or higher.	0x400	Receive task stack size. Legal values are 0x400 or higher.
Receive Task Priority	Legal values range from 0 through (Max Priorities - 1)	2	Receive task priority. Legal values range from 0 through (Max Priorities - 1). Also, set Accept Task, Receive Task, and Service Task with the same priority.
Service Task Stack Size	Legal values are 0x400 or higher.	0x400	Service task stack size. Legal values are 0x400 or higher.
Service Task Priority	Legal values range from 0 through (Max Priorities - 1)	2	Service task priority. Legal values range from 0 through (Max Priorities - 1). Also, set Accept Task, Receive Task, and Service Task with the same priority.
Maximum Number of Clients	Legal values are from 1 to 3.	3	Maximum number of connection sockets for clients. Valid values are 1 to 3.
Receive Queue Length	Legal values are 8 or higher.	8	The length of the queue that passes data between tasks. Legal values are 8 or higher.
Server ID	Legal values are from 1 to 255.	255	Modbus server ID. Legal values are from 1 to 255.

Configuration	Options	Default	Description
<b>Module Modbus TCP(r_modbus_tcp_server)</b>			
Name	Name Must Be a Valid C Symbol	g_modbus_tcp_server0	Module name.
Callback for Function Code	Name Must Be a Valid C Symbol	function_code_callback	Enter the user callback function name for "Function Code"
Additional Port Number	Legal values range from 0 to 65535. Also, do not specify the Modbus TCP Server default port number "502" with this property.	0	Modbus TCP Server listens on both the default port "502" and the port number specified in this property. Enter 0 if you do not want to use a port other than the default. Also, do not specify the Modbus TCP Server default port number "502" with this property.
IP List Status	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Enable	IP list enabled/disabled. If you want to use the IP list, select Enable. *1
IP List Mode	<ul style="list-style-type: none"> <li>• BlackList</li> <li>• WhiteList</li> </ul>	WhiteList	The selected option takes effect, if the "IP List Status" is "Enable". *1
IP Addresses	Enter Valid IP addresses between 0.0.0.0 ~ 255.255.255.255, and each IP address should be separated with commas.	192.168.1.101	Enter one or more IP addresses to register in the IP List. *1

\*1: For details, see " [9.2. Appendix B: IP List Related Parameters](#)" section.

## 9.2 Appendix B: IP List Related Parameters

IP List Status, IP List Mode, and IP Addresses are IP list-related parameters.

The settings for the "When not using an IP list", "When using an IP list as a WhiteList", and "When using an IP list as a BlackList" configurations are described below.

- When not using an IP list
  - IP List Status: Disable
  - IP List Mode: Any value (this configuration is invalid because IP List Status is "Disable")
  - IP Addresses: Any value (this configuration is invalid because IP List Status is "Disable")
- When using an IP list as a WhiteList
  - IP List Status: Enable
  - IP List Mode: WhiteList
  - IP Addresses: Any IP address to register as a WhiteList
    - If you are following the procedure explained in section "[8. Modbus Communication Using Modbus Demo Application](#)" to confirm the operation, set the IP address to "192.168.1.101".
- When using an IP list as a BlackList
  - IP List Status: Enable
  - IP List Mode: BlackList
  - IP Addresses: Any IP address to register as a BlackList
    - If you are following the procedure explained in section "[8. Modbus Communication Using Modbus Demo Application](#)" to confirm the operation, set the IP address other than "192.168.1.101".

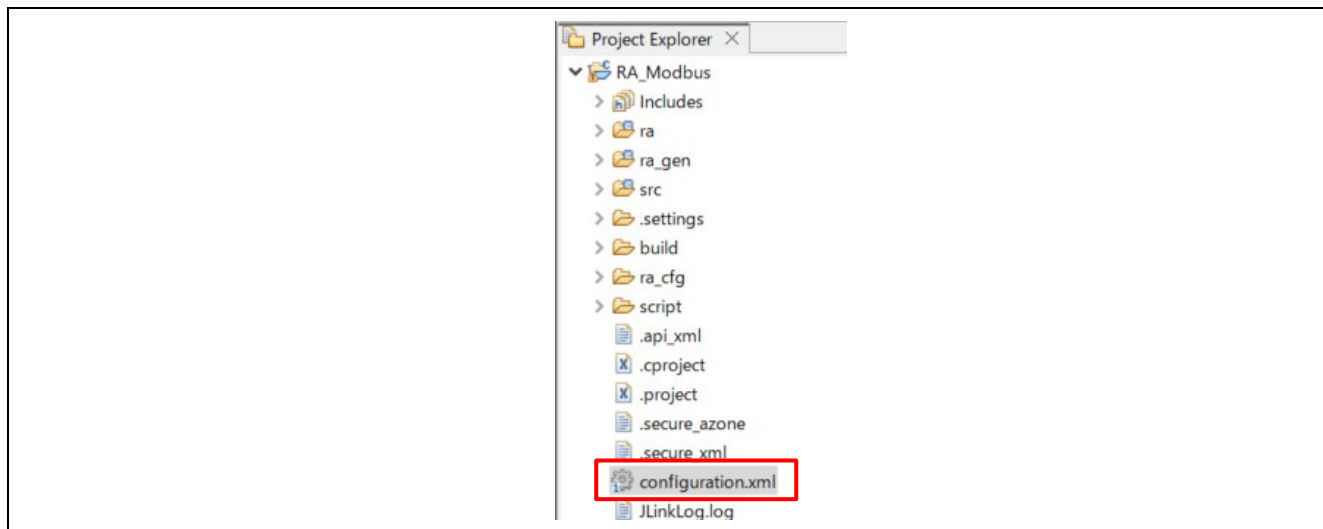
If multiple IP addresses need to be registered in the IP Addresses parameter, separate the IP addresses with a comma (",") as shown below.

Example: 192.168.1.101,192.168.1.102,192.168.1.103

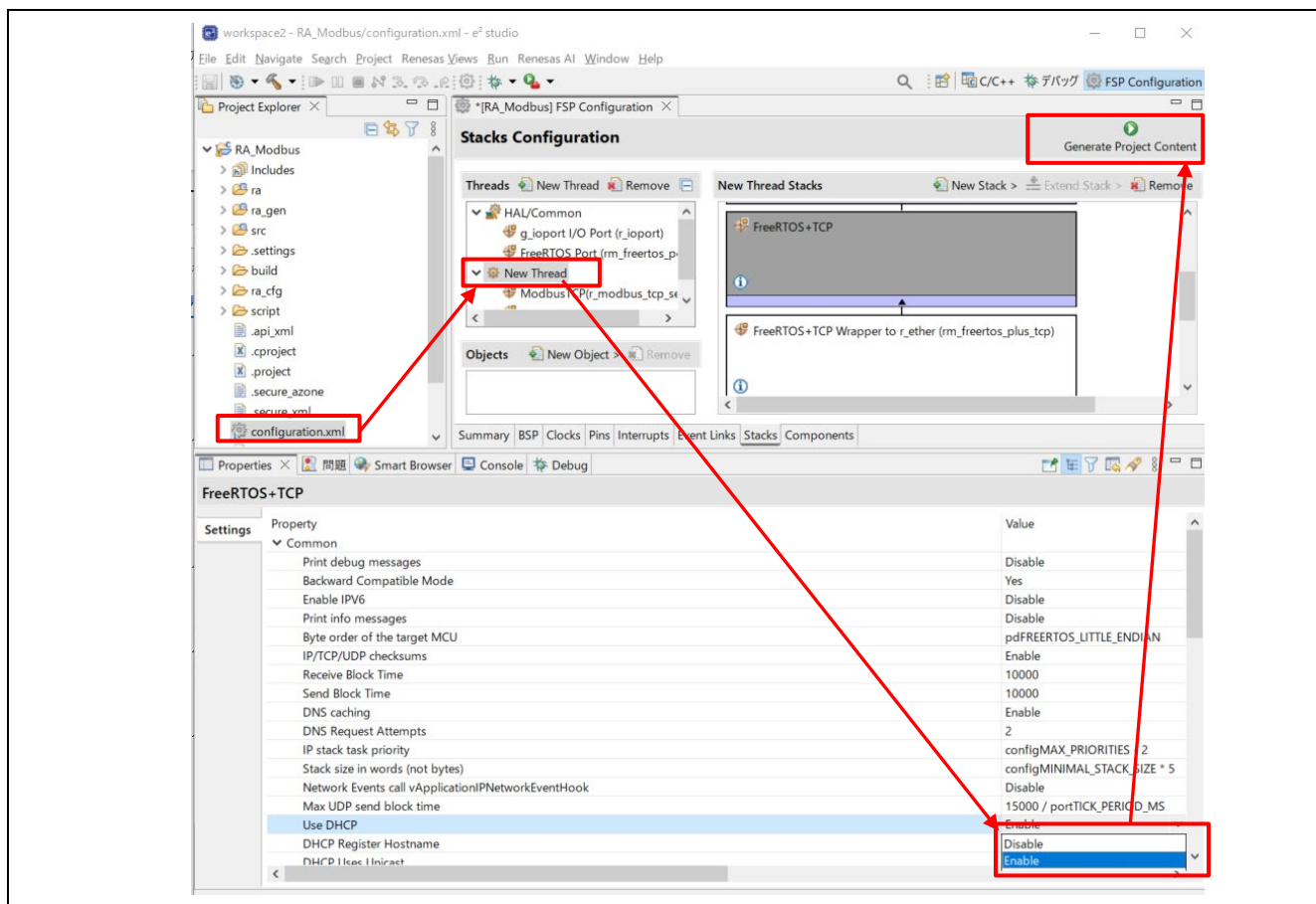
### 9.3 Appendix C: DHCP Mode

When the operation needs to be confirmed using DHCP mode, execute the procedure below:

1. Open configuration.xml from your Modbus project.



2. Click the "Stacks" tab to open the stack configuration screen and select "FreeRTOS + TCP" in the thread window on the left.
3. Open the properties, change "Use DHCP" to "Enable", and click the "Generate Project Content" button.



## 9.4 Appendix D: User-defined Function

This section describes the Modbus sample application. Users can register their own implementation of Modbus function code with the Modbus protocol stack.

### 9.4.1 Register Function Code

Definition file: src/modbus\_func.c

Define the function to be registered in the callback function of the Modbus protocol stack.

### 9.4.2 User-defined Functions

User-defined functions are defined in the src/modbus\_user.c

User-defined Read/Write functions are used to process each function.

Some functions access the following components of the evaluation board.

Evaluation Boards	User LED			User-Switch	
	①	②	③	①	②
EK-RA6M3	User LED1	User LED2	User LED3	User-Switch S1	User-Switch S2
EK-RA6M4	User LED1	User LED2	User LED3	User-Switch S1	User-Switch S2
EK-RA6M5	User LED1	User LED2	User LED3	User-Switch S1	User-Switch S2
EK-RA8D1	User LED1	User LED2	User LED3	User-Switch S1	User-Switch S2
EK-RA8M1	User LED1	User LED2	User LED3	User-Switch S1	User-Switch S2
MCK-RA8T1	LED1	LED2	LED3	-	-

Read/Write functions and tables are provided that correspond to each address of the coil/discrete input/holding register/input register.

The evaluation board parts and global variables accessed by the functions in each table are as follows.

#### 【Read Coils】

address	Access
0001	Above table User - LED①, g_coils_area
0002	Above table User - LED②, g_coils_area
0003	Above table User - LED③, g_coils_area
0004	g_coils_area
0005	g_coils_area
0006	g_coils_area
0007	g_coils_area
0008	g_coils_area

#### 【Write\_Single\_Coils】

address	access
0001	Above table User - LED①, g_coils_area *1
0002	Above table User - LED②, g_coils_area *1
0003	Above table User - LED③, g_coils_area *1
0004	g_coils_area
0005	g_coils_area
0006	g_coils_area
0007	g_coils_area
0008	g_coils_area

\*1 : Each LED on the evaluation board will turn on/off depending on the value written by this function.



**【Read\_Discrete\_Inputs】**

address	access
1001	g_discrete_input_area
1002	g_discrete_input_area
1003	g_discrete_input_area
1004	g_discrete_input_area
1005	g_discrete_input_area
1006	Above table User-Switch①, g_discrete_input_area *2
1007	Above table User-Switch②, g_discrete_input_area *2
1008	g_discrete_input_area
1009	g_discrete_input_area
10010	ILLEGAL DATA ADDRESS
10011	g_discrete_input_area
10012	g_discrete_input_area

\*2 : The value read by this function is displayed in "Discrete Inputs" of the Modbus demo application.

**【Read\_Discrete\_Inputs】**

address	access
3001	g_input_reg_area
3002	g_input_reg_area
3003	g_input_reg_area
3004	ILLEGAL DATA ADDRESS
3005	ILLEGAL DATA ADDRESS
3006	ILLEGAL DATA ADDRESS
3007	ILLEGAL DATA ADDRESS
3008	g_input_reg_area

**【READ\_HOLDING\_REGISTERS】**

address	access
4001	g_holding_reg_area
4002	g_holding_reg_area
4003	g_holding_reg_area
4004	ILLEGAL DATA ADDRESS
4005	ILLEGAL DATA ADDRESS
4006	ILLEGAL DATA ADDRESS
4007	g_holding_reg_area

**【WRITE\_SINGLE\_REGISTER】**

address	access
4001	g_holding_reg_area
4002	g_holding_reg_area
4003	g_holding_reg_area
4004	ILLEGAL DATA ADDRESS
4005	ILLEGAL DATA ADDRESS
4006	ILLEGAL DATA ADDRESS
4007	g_holding_reg_area

## 9.5 Appendix E: Multiple Client Communication

The Modbus protocol stack can connect up to three clients using Modbus communication.

If you create a project using the steps in "[6. Setting Up the Modbus Sample Project](#)", you can communicate continuously with the client under the following conditions.

- Number of clients: 3
- Communication interval: 1000ms
- Communication Timeout Time : 3000ms
- Do not connect devices that are not related to Modbus communication in the same network

If you want the communication interval or timeout time to be shorter than the above time, or if you need to connect other devices within the same network, change the following:

- Go to "Total number of available network buffers" property of "Stacks" → "FreeRTOS+TCP" → "Common" and increase its value.  
Note that the total number of available network buffers uses 56 bytes of RAM, and the amount of RAM used will increase proportionally to this value.  
(If the total number of available network buffers is 30, the amount of RAM used will be  $56 \times 30 = 1680$  bytes)
- Below is the settings for EK-RA6M3 / EK-RA6M4 / EK-RA6M5 / EK-RA8D1 / EK-RA8M1 / MCK-RA8T1.  
Go to "Stacks" → "g\_ether0 Ethernet" → "Module g\_ether0 Ethernet (r\_ether)" → "Buffers" → "Number of RX buffer" and change its value greater than or equal to 1 (default value). The recommended value is [Number of clients].  
(The RAM size used by the number of RX buffers is 1536 bytes.)  
(If you change the Number of RX buffer to 3, the total is  $1536 \times 3 = 4608$  bytes)

**Note:** If you want to use the Modbus sample project in your system, evaluate it thoroughly.

## Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jun.27.25	-	First version
1.10	Sep.25.25	Page 4 Page 6 Page 9 Page 18 - 43	<b>Added MCK-RA8T2</b> Updated "Table 1.2" Updated "3.1 Modbus Sample Project" Added "Figure 5.3" "6.2 Creation of new Modbus Project" is divided into common procedures for all evaluation boards and procedures for each evaluation board, and procedures for MCK-RA8T2 are added
		Page 7	<b>Updated Operating Environment Requirements</b> Updated "Table 4.1"
		Page 56	<b>Added description of multi-client communication</b> Added "9.5 Appendix E: Multiple Client Communication"
1.20	Oct.31.25	Page 4 Page 6 Page 9 Page 16  Page 45 – 67  Page 80	<b>Added EK-RA8D2, EK-RA8P1 and EK-RA8M2</b> Updated "Table 1.2" Updated "3.1 Modbus Sample Project" Updated "Figure 5.3" Changed the title of "6.1.2" to " MCK-RA8T2 / EK-RA8D2 / EK-RA8P1 / EK-RA8M2 Importing Procedures" Added "6.2.4 EK-RA8D2 Importing Procedures", "6.2.5 EK-RA8P1 Importing Procedures" and "6.2.6 EK-RA8M2 Importing Procedures" Changed "9.5 Appendix E: Multiple Client Communication"
		Page 7	<b>Updated Operating Environment Requirements</b> Updated "Table 4.1"
		Page 38	<b>Additional Procedures for Upgrading FSP Version</b> Added step 3 to "6.2.3"

# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

## 1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity.

Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

## 2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

## 3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

## 4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

## 5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

## 6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

## 7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

## 8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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